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I. INTRODUCTION

The effect of unplanned and ill-conceived land use development on the coastal ecology has been well documented in recent years.[1] Recognizing the need for more effective governmental control in this area, a number of state legislatures have enacted statutes to protect the coastal environment and encourage the orderly development of coastal resources.[2] These efforts have received the support of the federal government as well.[3]

Determination of coastal boundaries is essential to the development of an effective coastal zone management program.[4] In general such boundaries represent the intersection of the shore with a particular tidal elevation.[5] However, the demarcation of coastal boundaries is complicated by legal uncertainties. Moreover, the unavailability of accurate tidal data or the use of improper survey methods make the accurate location of the physical boundary line a difficult task in many cases.[6]

This article will examine a number of physical and legal problems

1. *See generally* B. KETCHUM, THE WATER'S EDGE: CRITICAL PROBLEMS OF THE COASTAL ZONE (1972); U.S. COMM'N ON MARINE SCIENCE, ENGINEERING AND RESOURCES, OUR NATION AND THE SEA: A PLAN FOR NATIONAL ACTION (1969).

2. *E.g.*, CAL. PUB. RES. CODE §§ 27000-650 (West Supp. 1974); N.C. GEN. STAT. §§ 113A-100 to -128 (1974 Advance Legislative Service, pamphlet no. 3); R.I. GEN. LAWS ANN. §§ 46-23-1 to -16 (Supp. 1973); WASH. REV. CODE ANN. §§ 90.58.010-.930 (Supp. 1972).

3. 16 U.S.C. §§ 1451-64 (Supp. II, 1972).

4. W. HULL, COASTAL BOUNDARY MAPPING 1 (1973).

5. 1 A. SHALOWITZ, SHORE AND SEA BOUNDARIES 89 (1962).

6. Guth, *Will the Real Mean High Water Line Please Stand Up*, 1974 PROCEEDINGS OF THE AM. SOC'Y OF PHOTOGRAMMETRY 33-44 (Fall Convention).

associated with coastal boundary determinations and offer some solutions within the framework of the legislative proposal which accompanies this discussion.

II. The Legal Regime of the Coastal Zone

A. *Littoral Rights*

Landowners, whose property borders on the ocean or a navigable watercourse,[7] commonly possess certain riparian or littoral rights.[8] These rights[9] depend upon contact with the water and not upon ownership of the submerged lands beneath it.[10] For example, littoral owners usually have a right of access to the water,[11] which cannot be impaired by the state without just compensation,[12] and they sometimes have rights to objects cast upon the shore.[13] Moreover, littoral owners share with other members of the public the right to navigate,[14] fish,[15] and

7. Strictly speaking, riparian or littoral rights properly attach only to land which abuts on navigable waters. However, landowners whose property borders on nonnavigable waters are often treated as riparian or littoral owners. *See* F. Maloney, S. Plager & F. Baldwin, Water Law and Administration—The Florida Experience § 22.1(a), at 35-36 (1968).

8. The term "riparian" is applied to fresh water streams, while the term "littoral" is used in connection with lakes and the seashore. 1 H. Farnham, The Law of Waters and Water Rights § 63 (1904).

9. Riparian and littoral rights also include the right to make consumptive uses, at least where fresh waters are concerned. *See generally* 5 R. Powell, The Law of Real Property §§ 710-18 (1971); 1 Waters and Water Rights §§ 15-16 (R. Clark ed. 1967).

10. 56 Am. Jur. *Waters* § 216 (1947).

11. McCloskey v. Pacific Coast Co., 160 F. 794 (9th Cir. 1908); San Francisco Sav. Union v. R.G.R. Petroleum & Mining Co., 144 Cal. 134, 135, 77 P. 823, 824 (1904); Board of Trustees v. Medeira Beach Nominee, Inc., 272 So. 2d 209, 214 (Fla. Dist. Ct. App. 1973); McCarthy v. Coos Head Timber Co., 208 Ore. 371, 387-88, 302 P.2d 238, 246 (1956); Hollan v. State, 308 S.W.2d 122, 125 (Tex. Civ. App. 1958); Lyon v. Fishmonger's Co., 1 App. Cas. 662 (1876); Annot., 89 A.L.R. 1156 (1934).

12. Lewis v. Johnson, 76 F. 476, 477 (D. Alas. 1896) (dictum); Hayes v. Bowman, 91 So. 2d 795, 799 (Fla. 1957); *In re* City of New York, 168 N.Y. 134, 61 N.E. 158 (1901); Duke of Buccleuch v. Metropolitan Bd. of Works, L.R. 5 H.L. 418 (1872); 1 H. Farnham, *supra* note 8, § 66; F. Maloney, S. Plager & F. Baldwin, *supra* note 7, § 41.1, at 98-99. *But see* cases discussed in Annot., 21 A.L.R. 206 (1922).

13. For example, seaweed and other natural objects thrown up by the sea belong to the landowner. Nudd v. Hobbs, 17 N.H. 524 (1845); Emans v. Turnbull, 2 Johns. 314 (N.Y. 1807). At common law the right to wreck was in the sovereign. Statute of Westminster of 1275, 3 Edw. 1, c. 4; Constable's Case, 77 Eng. Rep. 218, 223 (K.B. 1601); Note, *Abandoned Property: Title to Treasure Recovered in Florida's Territorial Waters*, 21 U. Fla. L. Rev. 360, 361-62 (1969). In America, however, the littoral owner may claim wreck. Barker v. Bates, 30 Mass. (13 Pick.) 255 (1832); Annot., 41 A.L.R. 1015, 1018 (1926).

14. Maloney & Plager, *Florida's Lakes: Problems in a Water Paradise*, 13 U. Fla. L. Rev. 1, 26-31 (1960).

15. Harris v. Brooks, 225 Ark. 436, 444, 283 S.W.2d 129, 134 (1955); Annot., 56 A.L.R.2d 790 (1957).

swim or bathe[16] in navigable waters, subject, however, to reasonable regulation by the state in the exercise of its police power.[17]

Finally, littoral property is subject to the doctrine of accretion, reliction, avulsion, and erosion,[18] which will be thoroughly discussed below.[19]

B. Public Trust Doctrine

No examination of property rights in the coastal zone would be complete without a discussion of the origin and scope of the public trust doctrine. In most jurisdictions the state owns the tidelands and beds under navigable waters; however, the character of this ownership differs in many respects from that of a private owner.[20] According to one commentator, "The public nature of state ownership is expressed in the trust principle, which means that the public is entitled to use the tidelands for certain purposes. In theory, at least, the states cannot destroy these public uses by devoting the tidelands to non-public uses."[21] In its modern form, therefore, the public trust doctrine limits the power of states to dispose of lands under tidal waters.[22] The doctrine has traditionally been employed to protect public rights to navigation, commerce and fishing,[23] but in some states it has also been utilized,[24] along

16. Butler v. Attorney General, 195 Mass. 79, 83, 80 N.E. 688, 689 (1907); People v. Hulbert, 131 Mich. 156, 159, 91 N.W. 211, 212 (1902); Harrison County v. Guice, 244 Miss. 95, 107, 140 So. 2d 838, 842 (1962); State v. Morse, 84 Vt. 387, 392, 80 A. 189, 191 (1911); *In re* Clinton Water Dist., 36 Wash. 2d 284, 287, 218 P.2d 309, 312 (1950).

17. Colberg, Inc. v. State, 67 Cal. 2d 408, 432 P.2d 3, 62 Cal. Rptr. 401 (1967), *cert. denied*, 390 U.S. 949 (1968); Carmazi v. Board of County Comm'rs, 108 So. 2d 318 (Fla. Dist. Ct. App. 1959); Note, *Colberg, Inc. v. State: Riparian Landowner's Right to Eminent Domain Relief for State Impairment of Access to a Navigable Waterway*, 72 DICK. L. REV. 375 (1968).

18. *See generally* 6 R. POWELL, *supra* note 9, §§ 983-86 (1973); 5A G. THOMPSON, COMMENTARIES ON THE MODERN LAW OF REAL PROPERTY §§ 2560-65 (J. Grimes ed. 1957); 56 AM. JUR. *Waters* §§ 476-98 (1947); 65 C.J.S. *Navigable Waters* §§ 80-87 (1966).

19. *See* Part III B(3) *infra*.

20. *See* Sax, *The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*, 68 MICH. L. REV. 471 (1970); Note, *The Public Trust in Public Waterways*, 7 URBAN L. ANNUAL 219 (1974).

21. Teclaff, *The Coastal Zone—Control over Encroachments into the Tidewaters*, 1 J. MARITIME L. & COMMERCE 241, 263 (1970).

22. *See* Comment, *The Tideland Trust: Economic Currents in a Traditional Legal Doctrine*, 21 U.C.L.A.L. REV. 826 (1974); Note, *Conveyances of Sovereign Lands Under the Public Trust Doctrine: When Are They in the Public Interest?*, 24 U. FLA. L. REV. 285 (1972).

23. *See* Comment, *The Public Trust in Tidal Areas: A Sometime Submerged Traditional Doctrine*, 79 YALE L.J. 762 (1970).

24. To date all of these cases have involved municipalities restricting access to

with other concepts,[25] to protect the public's access to upland beach areas for recreational purposes.

Although there were parallels in Roman law,[26] the public trust doctrine originated in the English common law.[27] Lord Hale in his treatise, *De Jure Maris*, distinguished between the proprietary interests of the sovereign and the rights of the public in tidal waters. Hale referred to the former as *jus privatum* and the latter as *jus publicum*.[28] The *jus privatum* was an aspect of the King's regalian rights and referred to ownership of the soil itself.[29] Any unauthorized encroachment on the foreshore or beds of tidal waters constituted an invasion of the King's private right and was deemed a purpresture,[30] and in the case of a wharf or other structure, the King could bring proceedings

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publically owned beaches to local residents. Borough of Neptune City v. Borough of Avon-By-The-Sea, 61 N.J. 296, 294 A.2d 47 (1972) ("The public trust doctrine like all common law principles, should not be considered fixed or static, but should be molded and extended to meet changing conditions and needs of the public it was created to benefit. . . ."); Gewirtz v. City of Long Beach, 69 Misc. 2d 763, 330 N.Y.S.2d 495 (Sup. Ct. 1972). *See also* Eckhardt, *A Rational National Policy on Public Use of Beaches*, 24 SYRACUSE L. REV. 967, 978-79 (1973); Note, *Non-Resident Restrictions in Municipally Owned Beaches: Approaches to the Problem*, 10 COLUM. J. LAW & SOC. PROB. 177 (1974); Note, *California Beach Access: The Mexican Law and the Public Trust*, 2 ECOL. L.Q. 571, 582-91 (1972); Note, *Access to Public Municipal Beaches: The Formulation of a Comprehensive Legal Approach*, 7 SUFFOLK U.L. REV. 936 (1973).

25. Theories based on immemorial custom, implied dedication and prescription have also been used by some state courts to provide for public access to the sea across privately owned beaches. Dietz v. King, 2 Cal. 3d 29, 465 P.2d 50, 84 Cal. Rptr. 162 (1970); City of Daytona Beach v. Tona-Rama, Inc., 294 So. 2d 73 (Fla. 1974); State *ex rel.* Thornton v. Hay, 254 Ore. 584, 462 P.2d 671 (1969); Seaway Co. v. Attorney General, 375 S.W.2d 923 (Tex. Civ. App. 1964); Note, *Public Access to Beaches: Common Law Doctrines and Constitutional Challenges*, 48 N.Y.U.L. REV. 369 (1973); Note, *Public Access to Beaches*, 22 STAN. L. REV. 564 (1970); Commentary, *Easements: Judicial and Legislative Protection of the Public's Rights in Florida's Beaches*, 25 U. FLA. L. REV. 586 (1973).

26. Apalachicola Land & Dev. Co. v. McRae, 86 Fla. 393, 98 So. 505 (1923); DIGEST 43.12.1.17; INSTITUTES 2.1.1, .2, .5; Comment, 79 YALE L.J., *supra* note 23, at 763-64.

27. *See generally* Fraser, *Title to the Soil Under Public Waters—A Question of Fact* (pts. 1-2), 2 MINN. L. REV. 313, 429 (1918).

28. Hale, *A Treatise Relative to the Maritime Law of England in Three Parts* in 1 A COLLECTION OF TRACTS RELATIVE TO THE LAW OF ENGLAND (F. Hargrove ed. 1787), *reprinted in* S. MOORE, A HISTORY OF THE FORESHORE 393 (1888) [hereinafter cited as S. MOORE]. Page references to Hale's work are taken from the Moore treatise. A substantial portion of Hale's treatise is also reprinted at the end of *Ex parte* Jennings, 6 Cow. 518, 536 (N.Y. 1826).

29. Fraser, *supra* note 27, at 433. Until restricted by Parliament in the eighteenth century, the King was free to alienate his *jus privatum* interest. Stat. 1 Anne, c. 7, § 5 (1701). *See also* Stat. 10 Geo. 4, c. 50 (1829), which placed royal property under the management of the commissioners of woods, forests and land revenues. Tidelands are now managed by the Crown Estate Commissioners. 39 HALSBURY'S LAWS OF ENGLAND, *Waters & Watercourses* § 775 (4th ed. 1962).

30. J. GOULD, A TREATISE ON THE LAW OF WATERS § 21 (3d ed. 1900).

in the Exchequer to seize the property or compel its removal.[31]

This private right, however, was subject to the *jus publicum*, under which public rights of fishing and navigation were protected.[32] According to Lord Hale, waterways were "in the nature of common highwayes, in which all the Kinges people have a liberty of passage."[33] Unlike the *jus privatum*, which was limited to tidal waters, the *jus publicum*, as it applied to navigation, extended to navigable fresh watercourses as well, even where the beds were privately owned.[34]

Although the King could convey his private interest in the soil,[35] he could not thereby impair the public's right to navigation.[36] Thus, if the owner of the tidelands erected a wharf or other structure that obstructed navigation his conduct was actionable as a public nuisance, notwithstanding the royal grant.[37]

The public right of fishing was less extensive than that of navigation.[38] The owner of the soil normally possessed exclusive fishing rights in nontidal waters, regardless of navigability.[39] However, in the

31. Gough v. Bell, 22 N.J.L. 441, 477 (Sup. Ct. 1850).

32. The right of the public to ports, which give it access to shore facilities for loading and unloading, was related to its right of navigation. Attorney-General v. Burridge, 147 Eng. Rep. 335 (Ex. 1822); Attorney-General v. Parmeter, 147 Eng. Rep. 345 (Ex. 1811); Attorney-General v. Richards, 145 Eng. Rep. 980 (Ex. 1795); Comment, 79 YALE L.J., *supra* note 23, at 781-82.

33. S. MOORE, *supra* note 28, at 339.

34. Palmer v. Mulligan, 3 Cai. R. 307, 313 (N.Y. Ct. App. 1805); S. MOORE, *supra* note 28, at 374-76.

35. Duke of Beaufort v. Mayor of Swansea, 154 Eng. Rep. 905 (Ex. 1849); Attorney-General v. Burridge, 147 Eng. Rep. 335 (Ex. 1822); Attorney-General v. Parmeter, 147 Eng. Rep. 345 (Ex. 1811); Blundell v. Catterall, 106 Eng. Rep. 1190 (K.B. 1821).

36. Gann v. Free Fishers, 11 Eng. Rep. 1305, 1312 (H.L. 1864); Attorney-General *ex rel.* Moore v. Wright, [1897] 2 Q.B. 318 (C.A.).

37. "The mode of proceeding at common law to authorize the erection of wharves and other structures on the shores of the sea or of navigable rivers, where the property remained in the Crown, was to sue out a writ of *ad quod damnum*, and upon the return of an inquest by a jury, finding that no injury would result to the king or others from the grant, the Crown licensed what would otherwise be a purpresture." J. GOULD, *supra* note 30, § 21, at 46-47; *see* Commonwealth v. Alger, 61 Mass. (7 Cush.) 53, 82 (1851); Clement v. Burns, 43 N.H. 609, 617 (1862); Bell v. Gough, 23 N.J.L. 624, 661 (Ct. Err. & App. 1852); Rex v. Russell, 108 Eng. Rep. 560 (K.B. 1827); Rex v. Montague, 107 Eng. Rep. 1183, 1184 (K.B. 1825); Note, *The Right of Sovereignty in the Shore of the Sea*, 1 AM. L. MAG. 76, 82 (1843).

38. At common law the right of fishery could be several, free or common. A several fishery was an exclusive right to fish in a particular watercourse; a free fishery was a right to fish shared with other holders of the same franchise, while a common fishery was that right possessed by all members of the public. *See* 7 M. BACON, ABRIDGEMENT OF THE LAW 452 (J. Bouvier ed. 1876); 16 C. VINER, A GENERAL ABRIDGEMENT OF LAW AND EQUITY 355 (2d ed. 1793).

39. J. GOULD, *supra* note 30, § 49, at 111-12; *see* Ewing v. Colquhoun, 2 App. Cas. 839 (1877); Pearce v. Scotcher, 9 Q.B.D. 162 (1882); Tilbury v. Silva, 45 Ch. D. 98 (1890); Murphy v. Ryan, 2 Ir. R.C.L. 143 (1868).

case of tidal waters, the public right of fishing was vested in the King as *jus publicum*.[40]

At first it appears that the King made grants of exclusive fishery in tidal waters to individuals and thereby excluded the public.[41] In *Lord Fitzwalter's Case*[42] Lord Hale stated that such grants were valid, but the right was prima facie in the public and the burden of proof was placed on the grantee to establish his interest.[43] Eventually in the nineteenth century, the courts determined that no grant of exclusive fishery in tidal waters was valid if made after the effective date of the Magna Carta.[44]

A somewhat different rule evolved in America. Many of the early colonial charters, granted at a time when the King could freely alienate his private interest in tidal waters, purported to grant havens, ports, rivers, waters, fishing rights, and "singular other commodities, jurisdictions, royalties, privileges, franchises, and pre-eminences, both within the tract of land upon the main, and within the islands and seas adjoining."[45] Moreover, no particular restriction was placed on the colonial proprietors' conveyances, except that public navigation not be impaired.[46] Nevertheless, a doctrine emerged in nineteenth-century America that imposed substantial restrictions on power of federal and state governments to abridge public rights of navigation and fishing or to alienate lands under navigable waters.[47] This became known as the

40. "The sea, and the arms of the sea, and the navigable waters in which the tide ebbs and flows, are the dominion of the king, . . . but that though the king is the owner of these waters, and, as consequent of his property, hath the primary right of fishing therein, yet the common people of England have regularly a liberty of fishing in the sea, and the creeks and arms thereof, as a public common piscary, and may not, without injury to their right, be restrained thereof." S. MOORE, *supra* note 28, at 376-77.

41. 1 H. FARNHAM, *supra* note 8, § 36.

42. 86 Eng. Rep. 766 (K.B. 1672).

43. "But in case of a river that flows and reflows, and is an arm of the sea, there, *prima facie*, it is common to all: and if any will appropriate a privilege to himself, the proof lieth on his side." *Id.* at 766-67.

44. Gann v. Free Fishers, 11 Eng. Rep. 1305, 1312 (H.L. 1865); Duke of Somerset v. Fogwell, 108 Eng. Rep. 325, 328 (K.B. 1826); Blundell v. Catterall, 106 Eng. Rep. 1190 (K.B. 1821); Mayor of Carlisle v. Graham, L.R. 4 Ex. 36 (1869). *See also* Browne v. Kennedy, 5 Har. & J. 195, 203-07 (Md. 1821).

45. The grant of King James I in 1620 to the Council of Plymouth, after which many of the later charters were modeled, included all "havens, ports, rivers, waters, fishings, mines, etc., and all and singular other commodities, jurisdictions, royalties, privileges, franchises, and preeminences, both within the tract of land upon the main, and within the islands and seas adjoining." J. GOULD, *supra* note 30, § 31, at 70; *see* Barker v. Bates, 30 Mass. (13 Pick.) 255, 259 (1832). *See also* Flaherty, *Virginia and the Marginal Sea: An Example of History in the Law*, 58 VA. L. REV. 694, 696 (1972).

46. 1 H. FARNHAM, *supra* note 8, § 42.

47. *E.g.*, Mayor v. Eslava, 9 Port. 577, 590-92 (Ala. 1839), *aff'd*, 41 U.S. (16 Pet.) 234 (1842); Kimball v. Macpherson, 46 Cal. 104 (1873); State v. Black River

public trust doctrine. The development of this concept may be traced in a series of federal cases beginning with *Martin v. Waddell*[48] decided in 1842.

The Supreme Court held in *Martin* that the plaintiff had not acquired an exclusive right of fishery through a grant from the colonial proprietor; rather, the dominion and property in the tidal waters were an aspect of the proprietor's governmental powers and were held in trust in the same manner as they were by the Crown. According to the Court, "When the revolution took place the people of each state became themselves sovereign, and in that character hold the absolute right to all their navigable waters in the soils under them for their own common use, subject only to the rights since surrendered by the constitution to the general government."[49]

Shortly thereafter, in *Pollard's Lessee v. Hagan*[50] the Court ruled that new states must be admitted on an equal footing with existing states and determined that title to tidelands in Mobile Bay were vested in the state of Alabama upon its admission to the Union in 1819. Later, in *Shively v. Bowlby*[51] the Court declared that prior to statehood, the federal government held the beds of tidal waters in trust for the citizens of the future state and could not alienate these lands so as to impair the trust.

The fullest exposition of the public trust doctrine appeared in

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Phosphate Co., 32 Fla. 82, 106, 13 So. 640, 648 (1893); Geiger v. Filor, 8 Fla. 325, 336 (1859); Browne v. Kennedy, 5 Har. & J. 157 (Md. 1821); Commonwealth v. City of Roxbury, 75 Mass. (9 Gray) 451, 492-93 (1858); Commonwealth v. Alger, 61 Mass. (7 Cush.) 65 (1851); Commonwealth v. Charleston, 18 Mass. (1 Pick.) 180, 181 (1822); Clement v. Burns, 43 N.H. 609, 616-17 (1862); Gough v. Bell, 23 N.J.L. 624, 654 (Ct. App. 1852); Arnold v. Mundy, 6 N.J.L., 67 (Ct. App. 1821); Coxe v. State, 144 N.Y. 396, 405, 39 N.E. 400, 402 (1895); Tatum v. Sawyer, 9 N.C. 226 (1822); Allen v. Allen, 19 R.I. 114, 32 A. 166 (1895) (per curiam); City of Galveston v. Menard, 23 Tex. 349, 393 (1859); Home v. Richards, 8 Va. (4 Call) 441 (1789).

Many American courts mistakenly believed that the Crown's title to tidal waters was directly related to its duty to preserve the public's right to navigation; *e.g.*, Illinois Cent. R.R. v. Illinois, 146 U.S. 387 (1892). This was partly due to a misunderstanding of the English test for navigability. Hale's treatise declared that the King protected public rights in nontidal waters that were navigable in fact. S. MOORE, *supra* note 28, at 374-76. However, Chancellor Kent, in Palmer v. Mulligan, 3 Cai. R. 307 (N.Y. Ct. App. 1805), introduced the tidal theory of navigability into American jurisprudence, holding that only tidal waters were navigable. This error led him to suggest a relationship between navigability and ownership of the soil which did not exist at common law, 1 H. FARNHAM, *supra* note 8, § 36a, but which provided a link between the English and American theories of governmental ownership of tidelands.

48. 41 U.S. (16 Pet.) 367 (1842).

49. *Id.* at 410; *accord*, Smith v. Maryland, 59 U.S. (18 How.) 71, 74-75 (1855).

50. 44 U.S. (3 How.) 212 (1845).

51. 152 U.S. 1 (1893).

Illinois Central Railroad v. Illinois.[52] The Illinois legislature in 1869 made a grant of submerged lands to the Illinois Central Railroad, including all the land underlying Lake Michigan for one mile out from shore and extending one mile in length along the central business district of Chicago. However, in 1873 the state revoked the grant and brought suit to have it declared invalid. The Supreme Court of the United States upheld the State's claim and declared that such a conveyance of trust lands to private parties was beyond the power of the State legislature. The Court stated that the title under which Illinois held the navigable waters of Lake Michigan was a "trust devolving upon the State for the public . . . which can only be discharged by the management and control of property in which the public has an interest, [and] cannot be relinquished by a transfer of property."[53]

It is important to note, however, that the Supreme Court held that the State, in the exercise of its management and control of such lands, could dispose of them in certain instances:

> [T]he abdication of the general control of the State over lands under the navigable waters of an entire harbor or bay, or of a sea or lake . . . is not consistent with the exercise of that trust which requires the government of the State to preserve such waters for the use of the public. . . . The control of the State for the purposes of the trust can never be lost, except as to such parcels as are used in promoting the interests of the public therein, or can be disposed of without any substantial impairment of the public interest in the lands and waters remaining.[54]

Thus, the states continue to have the primary responsibility for defining the limits of the public trust doctrine and formulating a policy concerning the disposition of sovereignty submerged lands within their respective boundaries.[55]

C. *Government Regulatory Authority*

While all property is subject to some form of public control, the unique physical and legal characteristics of coastal property invite a greater degree of governmental regulation. In fact, agencies of federal, state and local governments often impose substantial limitations

52. 146 U.S. 387 (1892).
53. *Id.* at 453.
54. *Id.* at 452-53.
55. Many states have enacted legislative restrictions concerning the sale of sovereignty submerged lands. Teclaff, *supra* note 21, at 261-68. The Florida Constitution prohibits such sales unless they are found to be in the public interest. FLA. CONST. art. X, § 11.

on the utilization and development of coastal resources by private landowners.

The federal government has a prominant role in coastal areas.[55] The National Ocean Survey (NOS) (formerly the Coast & Geodetic Survey) has been mapping the coastline of the United States since 1835.[57] The Corps of Engineers oversees dredge and fill operations in navigable waters, including coastal waters.[58] In addition, environmental legislation, such as the National Environmental Policy Act,[59] the Clean Air Act,[60] and the Federal Water Pollution Control Act[61] have a profound impact on the coastal zone. Finally, there is the Coastal Zone Management Act of 1972,[62] enacted to encourage the development of comprehensive state management programs and the formulation of a national coastal zone policy. Under this Act the Secretary of Commerce may award annual grants to coastal states to assist them in developing coastal management programs, while another provision requires coordination among federal and state agencies on matters involving coastal areas.[63]

In many states responsibility for the coastal environment is fragmented among various units of state and local government.[64] However, California,[65] North Carolina,[66] Rhode Island,[67] and Washington[68] have

56. *See* Teclaff, *supra* note 21, at 246, 251; Ausness, *Land Use Controls in Coastal Areas*, 9 CALIF. W.L. REV. 391, 401-04 (1973).

57. W. HULL, *supra* note 4, at 1. The National Ocean Survey (NOS) is a main line component of the National Oceanic and Atmospheric Administration (NOAA), an agency of the United States Department of Commerce.

58. 33 U.S.C. § 403 (1970). Hoyer, *Corps of Engineers Dredge and Fill Jurisdiction: Buttressing a Citadel Under Seige*, 26 U. FLA. L. REV. 19, 21 (1973); Kramon, *Section 10 of the Rivers and Harbors Act: The Emergence of a New Protection for Tidal Marshes*, 33 MD. L. REV. 229, 233 (1973).

59. 42 U.S.C. §§ 4321-47 (1970). *See, e.g.*, Natural Resources Defense Council, Inc. v. Morton, 458 F.2d 827 (D.C. Cir. 1972).

60. 42 U.S.C. §§ 1857-58 (1970).

61. 33 U.S.C. §§ 1251-1376 (Supp. II, 1972).

62. 16 U.S.C. §§ 1451-64 (Supp. II, 1972).

63. Ausness, *supra* note 56, at 403. Mandelker & Sherry, *The National Coastal Zone Management Act of 1972*, 7 URBAN L. ANNUAL 119 (1974).

64. *See generally* E. BRADLEY & J. ARMSTRONG, A DESCRIPTION AND ANALYSIS OF COASTAL ZONE AND SHORELINE MANAGEMENT PROGRAMS IN THE UNITED STATES (Sea Grant Tech. Rep. No. 20, 1972).

65. California Coastal Zone Conservation Act of 1972, CAL. PUB. RES. CODE §§ 27000-650 (West Supp. 1974). *See also* Douglas, *Coastal Zone Management—A New Approach in California*, 1 COASTAL ZONE MANAGEMENT J. 1 (1973); Comment, *Coastal Controls in California: Wave of the Future?*, 11 HARV. J. LEGIS. 463 (1974); Note, *Saving the Seashore: Management Planning for the Coastal Zone*, 25 HASTINGS L.J. 191 (1973).

66. N.C. GEN. STAT. §§ 113A-100 to -128 (1974 Advance Legislative Service, pamphlet no. 3). This statute is discussed in Schoenbaum, *The Management of Land*

all enacted comprehensive coastal zone management legislation. The Delaware Coastal Zone Act[69] prohibits the further introduction of heavy industry in coastal areas and closely regulates other manufacturing operations.[70] Other states have established coastal, construction-setback lines[71] and have enacted legislation to protect sand dunes[72] or the ocean shore in general.[73] Finally, most coastal states regulate construction activities in navigable waters[74] and estuarine areas.[75]

III. LEGAL ASPECTS OF SHORELINE BOUNDARIES

A. Tides

Coastal boundaries are generally defined by vertical datums, which are planes of reference for elevations based on the average rise and fall of the tide. Mean high water and mean low water are examples of such vertical datums. The coastal boundary is the intersection of this elevation with the shore and varies as the physical shape of the shore changes. Since observations of the tide provide the information necessary to establish these datums, an understanding of coastal boundaries requires a knowledge of tides and the forces that produce them.

The tide is defined, as: "The periodic rising and falling of the water that results from the gravitational attraction of the moon and sun

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and Water Use in the Coastal Zone: A New Law is Enacted in North Carolina, 53 N.C.L. REV. 275 (1974). *See also* R. Bode & W. Farthing, Coastal Area Management in North Carolina: Problems and Alternatives, Feb. 11, 1974 (N.C. Law Center publication).

67. Coastal Resources Management Act, R.I. GEN. LAWS ANN. §§ 46-23-1 to -16 (Supp. 1973).

68. Shoreline Management Act of 1971, WASH. REV. CODE ANN. §§ 90.58.010-.930 (Supp. 1973); Crooks, *The Washington Shoreline Management Act of 1971*, 49 WASH. L. REV. 423 (1974).

69. DEL. CODE ANN. tit. 7, §§ 7001-13 (Supp. 1972).

70. Note, *Legislation—The Delaware Coastal Zone Act*, 21 BUFFALO L. REV. 481, 482 (1972).

71. *E.g.*, FLA. STAT. ANN. §§ 161.052-.053 (1972); HAWAII REV. STAT. §§ 205-32, -34 (Supp. 1973).

72. N.C. GEN. STAT. § 104B-4 (1972). *See also* Note, *Environmental Law—The Public Trust Doctrine: A Useful Tool in the Preservation of Sand Dunes*, 49 N.C.L. REV. 973 (1971).

73. DEL. CODE ANN. tit. 7, §§ 6801-09 (Supp. 1972); ORE. REV. STAT. §§ 390.635-.690 (1973).

74. Teclaff, *supra* note 21, at 268-76; Annot., 46 A.L.R.3d 1422 (1972).

75. Ausness, *A Survey of State Regulation of Dredge and Fill Operations in Nonnavigable Waters*, 8 LAND & WATER L. REV. 65, 72-89 (1973); Note, *State and Local Wetlands Regulation: The Problem of Taking Without Just Compensation*, 58 VA. L. REV. 876 (1972).

acting upon the rotating earth."[76] This indicates the strong relationship between the sun and the moon and the tides.[77] The individual tide-producing forces vary over the face of the earth in a regular manner, but the different combinations of these forces produce totally different tides. Moreover, the response of various bodies of water to these forces varies because of differing hydrographic features of each basin.[78]

The variations in the major tide-producing forces are a result of changes in the moon's phases, declination to the earth, distance from the earth and regression of the moon's nodes.[79] The variations which occur because of this latter factor will go through one complete cycle in approximately 18.6 years. The other changes have cycles varying from 27⅓ days (moon's declination) to 27½ days (moon's distance) to 29½ days (moon's phases).[80] These cycles differ in magnitude, and their effect on the tide varies from place to place around the earth. The various combinations of all these changes also result in the daily variations in the tide at a given location.

The forces related to the changes in the moon's phases are strongest twice each month at new and full moon and the tides occuring at approximately these times are known as *spring tides.* These forces are weakest at the time of the first or third quarter of the moon and the tides occuring then are called *neap tides.* However, at most places there is a lag of a day or two between the occurrence of the appropriate phase of the moon and corresponding spring or neap tide.[81] The cycle relating to the moon's declination is strongest twice each month when the moon is at the tropics and it is weakest when the moon is over the equator. The tides associated with these changes are called tropic and equatorial tides when they are the strongest and weakest. The tides occurring when the moon is nearest the earth are called perigean tides and those occurring when the moon is farthest from the earth are called apogean tides.[82] A lag of a day or two is also found between the declination and the distance of the moon and the corresponding state of

76. P. SCHUREMAN, TIDE & CURRENT GLOSSARY 36 (U.S. Coast & Geodetic Survey Spec. Pub. No. 228, rev. ed. 1949).

77. The tide-producing power of the sun is somewhat less than one half of the tide-producing power of the moon. H. MARMER, TIDAL DATUM PLANES 2 (U.S. Coast & Geodetic Survey Spec. Pub. No. 135, rev. ed. 1951).

78. *Id.*

79. Roberts, *The Luttes Case—Locating the Boundary of the Seashore,* 12 BAYLOR L. REV. 141, 149 (1960).

80. H. MARMER, *supra* note 77, at 6.

81. Roberts, *supra* note 79, at 149.

82. H. MARMER, *supra* note 77, at 5.

the tide.[83]

There are three characteristic features of the tide at a given place—the time, range, and type of tide. The time of the tide is related to, and can be specified by, the moon's meridian passage.[84] The range of the tide refers to the magnitude of the rise and fall of the tide, and varies from day to day, at a given place depending on the relation of the tide-producing forces. The type of tide denotes the characteristic form of the daily rise and fall of the tide. The tide is semidiurnal when two highs and two lows occur each day; it is diurnal when only one high and one low occur each day; and it is mixed when two high and two low waters occur in a day with marked differences between the two high or the two low waters.[85]

These tidal characteristics vary from one location to another as a result of variations in the tide-producing forces and in hydrographic features.[86] While some generalizations about tidal characteristics can be made, it must be recognized that tidal characteristics are a local phenomenon and the description of the tide in one area may be inapplicable to another area.

The tide observations required for the determination of a tidal datum must be as accurate as possible because the location of the boundary determined from the datum may involve very valuable lands. After the vertical elevation of a tidal datum is established it must be translated into a line on the ground—the intersection of the datum plane with the shore. An error of only tenths of an inch in the tidal datum may result in the line of intersection moving a considerable distance landward or seaward if the shore has a flat slope. Therefore, the accuracy of coastal boundaries has a direct relation with the accuracy of the original tide observations.

The specific tidal datums that define the coastal boundaries provide the elevation of a stage of the tide on an average basis. For instance, mean high water is an average of the high waters. Because the magnitude of the rise and fall of the tide varies from day to day, tidal characteristics derived from daily observations may differ considerably from the average or mean values over a long period of time. Therefore, the average must be based on long-term observations before it can be

83. *Id.* at 5-6.
84. *Id.* at 3.
85. *Id.* at 4.
86. Roberts, *supra* note 79, at 150; Comment, *Fluctuating Shorelines and Tidal Boundaries: An Unresolved Problem*, 6 SAN DIEGO L. REV. 447, 450-51 (1969).

considered an accurate value for the tidal datum. When only short-term observations are available, they may be corrected to long-term mean values by comparison with simultaneous observations taken at some nearby location for which mean values have been determined from long-term observations. This process is described in Part IV.

Observations over a period of nineteen years are generally used to determine tidal datums because all the cycles related to the phases, declinations and distance of the moon occur within this period. In addition, the seasonal fluctuations of water level will be complete within a year, and the effects of these non-tidal forces can be balanced. When long-term observations are used to determine tidal datums, the datums will be applicable in future years unless the factors producing the tidal character have changed. The primary factor which might change and cause a variance in the datum will be the hydrographic features of the area.

B. The Limits of Private Ownership

(1) The Use of the Mean High Water Line to Delimit the Extent of Private Ownership

(a) Common-law developments

The Roman jurists regarded the sea and the foreshores as *res communes*, property which could be used by all, but which was incapable of private ownership.[87] At common law, however, the sovereign owned the sea and the seabed,[88] as well as the foreshore, by right of his prerogative as universal occupant,[89] although much of the foreshore was appropriated by private landowners prior to the sixteenth cen-

87. INSTITUTES 2.1.1; DIGEST 1.8.2; W. BUCKLAND, A TEXT-BOOK OF ROMAN LAW 184, 186 (1921). Several of the Medieval English commentators also adhered to this view. 89 SELDEN SOCIETY, FLETA 2-3 (H. Richardson & G. Sayles ed. 1972).

88. England claimed "dominion over portions of the North Sea, the Bay of Biscay, and the Atlantic from Cape Finisterre, Spain to Stadland, in Norway." E. BARTLEY, THE TIDELANDS OIL CONTROVERSY 8 (1953). *See also* The King v. Hampden, 3 How. State Trials 825, 1023 (Ex. 1637); Constable's Case, 74 Eng. Rep. 549 (K.B. 1578); S. MOORE, *supra* note 28, at 376-83; J. SELDEN, MARE CLAUSUM 363-75, 382-93 (1663); 7 SELDEN SOCIETY, MIRROR OF JUSTICES 8 (W. Whittaker ed. 1895). In the controversy over freedom of the seas in the early seventeenth century, English legal commentators maintained that the Crown had property as well as jurisdictional rights to sea, insisting that title to both the sea and the *fundus maris* or bed of the sea, *tam aquae quam soli*, was in the King. *See* J. GOULD, *supra* note 30.

89. "The King by our law is universal occupant, and all property is presumed to have been originally in the crown." 8 M. BACON, *supra* note 38, at 13; 2 W. BLACKSTONE, COMMENTARIES *51.

tury.[90] Shortly after the accession of Queen Elizabeth I, however, Thomas Digges, a lawyer, surveyor and engineer, advanced a new theory of royal ownership of the foreshore in his book, *Proofs of the Queen's Interest in Lands Left by the Sea and the Salt Shores Thereof*.[91] According to Digges, lands beneath tidal waters as well as the foreshore itself were a separate category of property which could be acquired only through express grant from the sovereign.[92] Apparently the Crown's claims were not at first accepted by the courts.[93] In the following century, Sir Matthew Hale, in his treatise, *De Jure Maris*, revived the Digges theory.[94]

Lord Hale distinguished between fresh water streams, the seabed and tidal waters.[95] According to Hale, the beds of fresh waters normally belonged to the riparian owner,[96] while the seabed belonged to the sovereign and was incapable of private ownership.[97] Tidal waters included arms and creeks of the sea as far as the ebb and flow of the tide,[98] as well as the foreshore "between the high-water mark and the low-water mark."[99] While Lord Hale admitted that the King could, and often did, make grants in tidal waters to his subjects,[100] he maintained that both the foreshore and the soil beneath arms of the sea

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90. *See generally* S. MOORE, *supra* note 28, at 1-168.

91. Fraser, *supra* note 27, at 317.

92. 1 H. FARNHAM, *supra* note 8, § 39a.

93. Viner's Abridgment mentions the unreported case of *Digges v. Hammond* in which the Court of the Exchequer, around the year 1575, held that title in a salt marsh around Sandwich was in the upland owner rather than in the Queen. 16 C. VINER, *supra* note 38, at 575. *See also* Constable's Case, 77 Eng. Rep. 218 (K.B. 1601); Anonymous, 73 Eng. Rep. 737 (K.B. 1573).

94. The treatise was apparently written around 1666. It was discovered at Hale's death in 1676 but was not published until 1787. Note, *Lord Hale and Business Affected with a Public Interest*, 43 HARV. L. REV. 759 (1930).

95. The second part of Hale's treatise, entitled *De Jure Portibus*, dealt with public and private rights with respect to harbors and ports. Comment, 79 YALE L.J., *supra* note 23, at 782.

96. S. MOORE, *supra* note 28, at 370-72; *see* Carter v. Murcot, 98 Eng. Rep. 127 (K.B. 1786); The King v. Wharton, 88 Eng. Rep. 1483 (K.B. 1702); Murphy v. Ryan, 2 Ir. R.C.L. 143 (1868).

97. S. MOORE, *supra* note 28, at 376.

98. "For the second; that is called an arm of the sea where the sea flows and reflows; and so far only as the sea flows and reflows." *Id.* at 378.

99. *Id.*

100. Although the king hath *prima facie* this right in the arms and creeks of the sea *communi jure*, and in common presumption, yet a subject may have such a right. And this he may have two ways. 1st. By the king's charter or grant; and this is without question . . . 2d. The second right is that which is acquired or acquirable to a subject by custom or prescription; and I think it very clear, that the subject may by custom and usage or prescription have the true propriety and interest of many of these several maratime interests, which we have before stated to be *prima facie* belonging to the king.

Id. at 384-85.

"prima facie" belonged to the King.[101] "It is admitted that *de jure communi* between the high water mark doth *prima facie* belong to the king . . . Although it is true, that such shore may be, and commonly is parcel of the manor adjacent, and so may be belonging to a subject, as shall be shown, yet *prima facie* it is in the king's."[102]

To support his theory of royal ownership, Lord Hale relied on *Philpott's Case*,[103] decided in 1632. This decision, however, was not reported, and *Johnson v. Barret*,[104] decided more than a decade later, appeared to follow the older rule. The first reported case to reflect Hale's position was *Bulstrode v. Hall*[105] in 1662. The new doctrine became firmly established by the end of the seventeenth century[106] and, since that time, the ordinary high water mark has been considered the usual boundary between public and privately-owned property in England.[107] At the present time, one who asserts a claim to land below the high water mark has the burden of proof and must establish his title by prescription or express grant from the King.[108]

The English rule was accepted by most American jurisdictions and is now followed in Alabama,[109] Alaska,[110] California,[111] Conneticut,[112]

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101. *Id.* at 10-25.

102. *Id.* at 12-13.

103. 8 Car. 1, f. 66 (1632). The *Philpott* case was discussed in Attorney-General v. Chamberlaine, 70 Eng. Rep. 122, 123 (V. Ch. 1858); Attorney-General v. Richards, 145 Eng. Rep. 980 (Ex. 1795). *See also* 16 C. VINER, *supra* note 38, at 576. *But see* 1 H. FARNHAM, *supra* note 8, § 39b. The decree is reprinted in S. MOORE, *supra* note 28, at 895-907.

104. 82 Eng. Rep. 887 (K.B. 1646).

105. 82 Eng. Rep. 1024 (K.B. 1662). "Et in cest case fuit soven foits affirme & nient deny que le soil de touts rivers cy haut que la est fluxum & refluxum maris est in le Roy & nemy in les siegneurs des mannors &c. sans prescription." (It was frequently affirmed and never denied that the soil to all rivers as high as the tide ebbs and flows is in the King, and never in the lords of the manors without grant or prescription.) *Id.*

106. Earl of Salisbury v. Joyn, 84 Eng. Rep. 992 (K.B. 1676); Whitaker v. Wife, 84 Eng. Rep. 479 (K.B. 1670); Kirby v. Gibs, 84 Eng. Rep. 183 (K.B. 1666).

107. Duke of Beaufort v. Mayor of Swansea, 154 Eng. Rep. 905 (Ex. 1849); Attorney-General v. Burridge, 147 Eng. Rep. 335, 342 (Ex. 1822); Attorney-General v. Parmeter, 147 Eng. Rep. 345, 352 (Ex. 1811); Rex v. Smith, 99 Eng. Rep. 283 (K.B. 1780); Warren v. Matthews, 91 Eng. Rep. 312 (K.B. 1704); Le Strange v. Rowe, 176 Eng. Rep. 903 (N.P. 1866).

108. However, it can be argued that this was a rule of evidence rather than a principle of substantive law. *See* Fraser, *supra* note 27, at 321-22.

109. United States v. Property on Pinto Island, 74 F. Supp. 92, 104 (S.D. Ala. 1947); City of Mobile v. Eslava, 9 Port. 577 (Ala. 1839), *aff'd*, 41 U.S. 234 (1842).

110. Demmert v. City of Klawock, 199 F.2d 32, 33 (9th Cir. 1952); ALASKA STAT. § 38.05.320 (1962).

111. People v. William Kent Estate Co., 242 Cal. App. 2d 156, 51 Cal. Rptr. 215, 218 (1st Dist. Ct. App. 1966); Katenkamp v. Union Realty Co., 11 Cal. App. 2d 63,

Florida,[113] Maryland,[114] Mississippi,[115] New Jersey,[116] New York,[117] North Carolina,[118] Oregon,[119] Rhode Island,[120] South Carolina[121] and Washington.[122] Some states, however, have departed from the common law position. Massachusetts[123] and Maine,[124] for example, recognize the low water line in accordance with a colonial ordinance. Delaware,[125] Georgia,[126] New Hampshire,[127] Pennsylvania[128] and Virginia[129] also use the low water line. Texas recognizes the English posi-

53 P.2d 390 (3d Dist. Ct. App. 1935), *rev'd on other grounds*, 6 Cal. 2d 765, 59 P.2d 473 (1936); CAL. CIV. CODE § 670 (West 1954).

112. Bloom v. State Water Resources Comm'n, 157 Conn. 528, 254 A.2d 884 (1969). State v. Knowles-Lombard Co., 122 Conn. 263, 265-66, 188 A. 275, 276 (1936).

113. Trustees of Internal Improvement Fund v. Wetstone, 222 So. 2d 10, 14 (Fla. 1969); Miller v. Bay-to-Gulf, Inc., 141 Fla. 452, 458, 193 So. 425, 427 (1940); White v. Hughes, 139 Fla. 54, 61, 190 So. 446, 449 (1939); FLA. CONST. art. X, § 11.

114. Van Ruymbeke v. Patapsco Indus. Park, 261 Md. 470, 475, 276 A.2d 61, 64 (1971); Troy v. Atlantic Gulf & Pac. Co., 176 Md. 197, 206, 4 A.2d 757, 762 (1939).

115. Harrison County v. Guice, 244 Miss. 95, 106, 140 So. 2d 838, 842 (1962); State *ex rel.* Rice v. Stewart, 184 Miss. 202, 228-31, 184 So. 44, 49-50 (1938), *aff'd on rehearing*, 184 Miss. 204, 185 So. 247 (1939); Rouse v. Saucier's Heirs, 166 Miss. 704, 712-13, 146 So. 291, 291-92 (1933); Money v. Wood, 152 Miss. 17, 28-30, 118 So. 357, 359-60 (1928).

116. O'Neil v. State Highway Dep't, 40 N.J. 307, 235 A.2d 1 (1967); Baily v. Driscoll, 19 N.J. 363, 367, 117 A.2d 265, 267 (1955).

117. Tiffany v. Oyster Bay, 209 N.Y. 1, 102 N.E. 585 (1913); *In re* Site for Hunts Point Sewage Treatment Works, 281 App. Div. 315, 119 N.Y.S.2d 391, 404 (1953); Gucker v. Town of Huntington, 254 App. Div. 10, 3 N.Y.S.2d 788, 790-91 (1938).

118. Carolina Beach Fishing Pier, Inc. v. Town of Carolina Beach, 277 N.C. 297, 177 S.E.2d 513 (1970).

119. Winston Bros. Co. v. State Tax Comm'n, 156 Ore. 505, 510, 62 P.2d 7, 9 (1936); Hume v. Rogue River Packing Co., 51 Ore. 237, 243, 92 P. 1065, 1068 (1907).

120. Attorney General *ex rel.* Jackvony v. Powel, 67 R.I. 218, 21 A.2d 554 (1941); Allen v. Allen, 19 R.I. 114, 32 A. 166 (1895).

121. Cape Romain Land & Improvement Co. v. Georgia-Carolina Canning Co., 148 S.C. 428, 146 S.E. 434 (1928).

122. Hughes v. State, 67 Wash. 2d 799, 410 P.2d 20 (1966); Harkins v. Del Pozzi, 50 Wash. 2d 237, 310 P.2d 532 (1957); Wilson v. Howard, 5 Wash. App. 169, 486 P.2d 1172 (1971).

123. Michaelson v. Silver Beach Improvement Ass'n, Inc., 342 Mass. 251, 253, 173 N.E.2d 273, 275 (1961); Iris v. Town of Hingham, 303 Mass. 401, 403, 22 N.E.2d 13, 15 (1939). The ordinance of 1647 provides that the low water mark shall be used if it does not extend more than one hundred rods, about 1650 feet, beyond the high water mark.

124. *In re* Hadlock, 142 Me. 116, 119, 48 A.2d 628, 630 (1946); Sinford v. Watts, 123 Me. 230, 232, 122 A. 573, 574 (1923); Snow v. Mt. Desert Island Real Estate Co., 84 Me. 14, 17, 24 A. 429, 430 (1891).

125. State *ex rel.* Buckson v. Pennsylvania R.R., 228 A.2d 587, 601 (Del. Super. Ct. 1967).

126. GA. CONST. art. 1, § 6; GA. CODE ANN. § 85-1309 (1970).

127. Nudd v. Hobbs, 17 N.H. 524 (1845).

128. Commonwealth *ex rel.* Hansel v. Y.M.C.A., 169 Pa. 24, 38, 32 A. 121, 127 (1895); Wall v. Pittsburgh Harbor Co., 152 Pa. 427, 25 A. 647 (1893); Matthews v. Bagnik, 157 Pa. Super. 115, 119, 41 A.2d 875, 877 (1945).

129. Whealton & Wisherd v. Doughty, 116 Va. 566, 572, 82 S.E. 94, 96 (1914);

tion with respect to common law grants,[130] but uses the line of higher high tide when Spanish or Mexican grants are involved.[131] Louisiana has adopted the civil law boundary of the line highest winter tide.[132] And in Hawaii, the upland owner has title to the upper reaches of the wash of the waves.[133]

(b) *The Borax decision*

At common law as a general rule the foreshore belonged to the sovereign while upland property was privately owned. All lands covered by the "flux and reflux of the sea at ordinary tides" were deemed to be part of the foreshore.[134] Therefore, the "ordinary high-water mark constituted the landward limit (and the ordinary low-water mark constituted the seaward limit) of the foreshore.[135] Moreover, the ordinary high water mark also constituted the seaward limit of the upland. Its utility as a property boundary was substantially reduced, however, because of the obscurity associated with the concept of the "ordinary" tide.

In his treatise *De Jure Maris*, Lord Hale described three varieties of tides: (1) the high spring tides which occur at the two equinoctial periods;[136] (2) the spring tides which occur twice a month at the full and change of the moon;[137] and (3) ordinary tides or neap tides, which

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Groner v. Foster, 94 Va. 650, 657, 27 S.E. 493, 496 (1897); VA. CODE ANN. §§ 62.1-.2 (1973).

130. Rudder v. Ponder, 156 Tex. 185, 193, 293 S.W.2d 736, 741 (1956); DeMerit v. Robinson, 102 Tex. 358, 361, 116 S.W. 796, 797 (1909).

131. Luttes v. Texas, 159 Tex. 500, 324 S.W.2d 167 (1958). The line of mean higher high tide is the higher of the daily high tides at a particular locality over a nineteen year period. Where there are two high tides per day, the line of mean higher high tide will be above the line of mean high tide, but where there is only one high tide per day the lines will be identical. *See generally* City of San Francisco v. Le Roy, 138 U.S. 656 (1891); United States v. Pacheco, 69 U.S. (2 Wall.) 587 (1864); Apalachicola Land & Dev. Co. v. McRea, 86 Fla. 393, 98 So. 505 (1923); Brickell v. Trammell, 77 Fla. 544, 82 So. 221 (1919).

132. 3 LA. CIV. CODE ANN. art. 451 (West 1952). In the case of a Spanish land grant, however, the mean high water line is used. New Orleans Land Co. v. Board of Levee Comm'rs, 171 La. 718, 132 So. 121 (1930).

133. Application of Ashford, 50 Hawaii 314, 316-17, 440 P.2d 76, 77-78 (1968).

134. Blundell v. Catterall, 106 Eng. Rep. 1190, 1199 (K.B. 1821).

135. 1 A. SHALOWITZ, *supra* note 5, at 90.

136. "The high spring tides, which are the fluxes of the sea at those tides that happen at the two equinoxials; and certainly this doth not *de jure communi* belong to the crown. For such spring tides many times overflow ancient meadows and salt marshes, which yet unquestionably belong to the subject." S. MOORE, *supra* note 28, at 393.

137. "The spring tides which happen twice every month, at full and change of the moon, and the shore in question, is by some opinion not denominated by these tides neither, but the land overflowed by these fluxes ordinarily belong to the subject *prima facie*, unless the King hath a prescription to the contrary." *Id.*

happen between the full and change of the moon.[138] Only the last category of tides, according to Hale, should be used to determine the high water mark. This formulation first received judicial recognition in *Kirby v. Gibs*,[139] a seventeenth century case, in which the reporter remarked "Note, the high water marks [*sic*] is as far as is overflowed by inepe tides or ordinary tides."[140]

Unfortunately, it was not altogether clear whether "neap tides" to Hale meant ordinary or usual tides or whether he was referring only to those tides which occur twice monthly at the moon's quadratures.[141] This uncertainty was not entirely resolved until *Attorney General v. Chambers* in the mid-nineteenth century.[142] *Chambers* involved a dispute between the Crown and a littoral owner over coal deposits under the foreshore. At issue was the precise location of the boundary between their respective tracts. Both parties agreed that this boundary was the "ordinary high-water mark."[143] The defendant, however, argued that the ordinary high-water mark was comprised of neap tides only, while the Crown urged that the "medium line of high water-mark between neap and spring tides" was the proper standard.

According to the Chancellor, the high water mark rule was intended to vest the littoral proprietor with the land which was for the most part dry and usable, while leaving the Crown only that land which was incapable of ordinary cultivation. Therefore, only the usual or ordinary tides should be considered. Unusually high (spring) and unusually low (neap) tides should be ignored for purposes of determining the extent of private ownership. The ordinary high-water mark was, therefore, declared to be "the line of the medium high tide between the springs and the neaps."[144]

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138. "Ordinary tides or neap tides, which happen between the full and change of the moon; and this is that which properly *littus maris*. . . . And touching this kind of shoar, viz. that which is covered by the ordinary flux of the sea, is the business of our present enquiry." *Id.*

139. 84 Eng. Rep. 183 (K.B. 1666).

140. *Id.*

141. Gay, *The High Water Mark: Boundary Between Public and Private Lands*, 18 U. FLA. L. REV. 553, 560 (1966). One commentator, writing in 1830, interpreted the term "neap tides," as used by Lord Hale, to mean those tides which occur "twice in the twenty-four hours." Hall, *Essay on the Rights of the Crown and the Privileges of the Subject in the Sea-Shores of the Realm* (1830), *reprinted in* S. MOORE, *supra* note 28, at 667-892.

142. 43 Eng. Rep. 486 (Ch. 1854).

143. *Id.* at 488.

144. *Id.* at 490.

Although some American courts cited the *Chambers* decision with approval,[145] and adopted the Chancellor's "medium high tide" formulation,[146] most of the American cases prior to the *Borax* decision merely spoke of the "high water mark"[147] or the "ordinary high water mark"[148] without attempting a precise definition. While some decisions mentioned Lord Hale's treatise, *De Jure Maris*,[149] no attempt was made to clarify Hale's ambiguous use of the term "neap tides."[150] Angell's treatise, written in 1847, for example, declared that in the United States private ownership extended "down to the edge of the high water mark of the ordinary or neap tides."[151] This confusion was reflected in *Teschemacher v. Thompson*,[152] a leading nineteenth century case, in which the court defined the "ordinary high water mark" as "the limit reached by the neap tides; that is, those tides which happen between the full and change of the moon, twice in every twenty-four hours."[153] Although it cited English authority, the court was apparently unaware of the *Chambers* case, decided seven years earlier. Moreover, the language of the *Teschemacher* decision itself was unclear and inaccurate. The court apparently believed, as Hale did, that all tides are either spring or neap; that spring tides occur but once a month and that all other tides are neap tides and differ little among themselves, making them usual or "ordinary" tides.[154] The *Teschemacher* case has been followed in California[155] and has apparently led a court into similar error in at least one other state.[156]

145. Commonwealth v. Roxbury, 15 Mass. (9 Gray) 451, 483 (1857); Stevens v. Patterson & N.R.R., 34 N.J.L. 532, 541 (Ct. Err. & App. 1870).

146. East Boston Co. v. Commonwealth, 203 Mass. 68, 89 N.E. 236 (1909); New Jersey & Iron Co. v. Morris Canal & Banking Co., 44 N.J. Eq. 398, 401, 15 A. 227, 228 (1888).

147. *E.g.*, Storer v. Freeman, 6 Mass. 435, 439 (1810).

148. *E.g.*, Mather v. Chapman, 40 Conn. 382, 394 (1873); Church v. Meeker, 34 Conn. 421, 424 (1867); French v. Bankhead, 51 Va. 65, 73, 11 Gratt. 136, 160 (1854).

149. *E.g.*, Mather v. Chapman, 40 Conn. 382, 400 (1873); Church v. Meeker, 34 Conn. 421, 424 (1867); Storer v. Freeman, 6 Mass. 435, 439 (1810); *Ex parte* Jennings, 6 Cow. 518 (N.Y. 1826).

150. *See, e.g.*, Commonwealth v. Rosbury, 75 Mass. (9 Gray) 451, 483 (1858).

151. J. ANGELL, TIDE WATERS 71 (2d ed. 1847); Gay, *supra* note 141, at 561.

152. 18 Cal. 11 (1861).

153. *Id.* at 21-22.

154. 1 A. SHALOWITZ, *supra* note 5, at 93.

155. Otey v. Carmel Sanitation Dist., 219 Cal. 310, 26 P.2d 308 (1933). City of Oakland v. E.K. Wood Lumber Co., 211 Cal. 16, 292 P. 1076 (1930); Forgeus v. Santa Cruz County, 24 Cal. 193, 140 P. 1092 (3d Dist. Ct. App. 1914). A California court in People v. William Kent Estate Co., 242 Cal. App. 2d 156, 51 Cal. Rptr. 215 (1st Dist. Ct. App. 1966), held that the term "neap tides" as used in the *Teschemacher* case referred to true twice-a-month neap tides rather than ordinary or daily high tides.

156. Miller v. Bay-to-Gulf, Inc., 141 Fla. 452, 193 So. 425 (1940).

Borax Consolidated Ltd. v. City of Los Angeles[157] is the leading American decision on the methodology of coastal boundary determination. The case involved the boundary between the upland and the foreshore of Mormon Island in San Pedro Harbor. The upland property was owned by the Borax Company under a patent from the federal government while the foreshore and adjacent submerged lands belonged to the City of Los Angeles under a grant from the State of California.[158] The City's suit to quiet title was dismissed by the district court on the ground that the limits of the federal grant could not be determined in such a proceeding.[159] On appeal, the court of appeals reversed, and construed the "ordinary high water mark" as the "mean high-tide line," rejecting the neap tide standard proposed by the Borax Company.[160] This decision was affirmed on appeal by the United States Supreme Court.[161]

The Supreme Court emphasized that the term "ordinary high water mark" meant the intersection of a tidal plane with the shore, and had no particular relation to a physical mark or vegetation line: "The tideland extends to the high water mark . . . . This does not mean, as petitioners contend, a physical mark made upon the ground by the waters; it means the line of high water as determined by the course of the tides."[162]

After reviewing Lord Hale's definition of the foreshore and the language of the *Chambers* case, the Supreme Court declared: "in determining the limit of the federal grant, we perceived no justification for taking neap high tides, or the mean of those tides, as the boundary between upland and tideland, and for thus excluding from the shore the land which is actually covered by the tide most of the time."[163] Instead the Court adopted the mean high tide line standard and the survey methodology described in such Coast Survey publications as Marmer's *Tidal Datum Planes*:[164]

> In view of the definition of the mean high tide, as given by the United States Coast and Geodetic Survey that 'mean high water

157. 296 U.S. 10 (1935).
158. Ch. 115, [1917] Cal. Laws 159; ch. 656, [1911] Cal. Laws 1256.
159. City of Los Angeles v. Borax Consol. Ltd., 5 F. Supp. 281 (S.D. Cal. 1933).
160. 74 F.2d 901 (9th Cir. 1935).
161. 296 U.S. 10 (1935).
162. *Id.* at 22. *But see* Udall v. Oelschlaeger, 389 F.2d 974 (D.C. Cir.), *cert. denied*, 392 U.S. 909 (1968).
163. 296 U.S. at 26-27.
164. Especially H. MARMER, *supra* note 77.

> at any place is the average height of all the high waters at that place over a considerable period of time,' and the further observation that 'from theoretical considerations of an astronomical character' there should be 'a periodic variation in the rise of water above sea level having a period of 18.6 years,' the Court of Appeals directed that in order to ascertain the mean high tideline with requisite certainty in fixing the boundary of valuable tidelands, such as those here in question appear to be, 'an average of 18.6 years should be determined as near as possible.' We find no error in that instruction.

While the question before the Supreme Court in the *Borax* case was the interpretation of the phrase "line of mean high tide" as used in a statutory grant to the City, the Supreme Court equated "mean" with "ordinary" and clearly considered the term "mean high water line" equivalent to the common-law "ordinary high-water mark," as defined by the court in *Chambers.* This approach is justified because the spring tides occur with the same frequency as the neap tides, and since one is as much above a medium plane as the other is below it, these tides cancel each other. Moreover, it is considerably easier from a technical point of view to determine a plane of mean high water which includes all tides than to calculate a plane that excludes spring and neap tides.[165]

The *Borax* definition of ordinary high tide must be used to determine the seaward boundary of any federal grant.[166] Arguably, therefore, *Borax* may, for most purposes, overrule contrary state decisions. Nevertheless, since *Borax* is limited to federal grants, the case apparently would not be binding in Texas or the original states which have no federal public domain lands. Moreover, presumably *Borax* would not apply to valid French, Spanish or Mexican grants made prior to acquisition of these areas by the United States,[167] thus limiting its application in some parts of Florida, the Gulf Coast, and California.

Because *Borax* is a progressive decision which incorporates the most accurate methodology for determining tidal boundaries; it has been followed by a number of state courts[168] and should eventually displace the older common-law "ordinary high water mark" standard.

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165. 1 A. SHALOWITZ, *supra* note 5, at 96.

166. 296 U.S. at 22.

167. Carpenter v. City of Santa Monica, 63 Cal. App. 2d 772, 783-87, 147 P.2d 964, 970-72 (1944).

168. O'Neill v. State Highway Dep't, 50 N.J. 307, 323-24, 235 A.2d 1, 9-10 (1967); Carolina Beach Fishing Pier, Inc. v. Town of Carolina Beach, 277 N.C. 297, 303, 177 S.E.2d 514, 516 (1970); Wilson v. Howard, 5 Wash. App. 169, 486 P.2d 1172 (1971).

(2) Private Property Rights in Tidally Affected Areas

(a) *Tests of navigability for title purposes*

Since the mean high water line is the intersection of the plane of mean high water with the shore, in theory it can be located wherever a tidal effect can be found.[169] It does not necessarily follow, however, that the mean high water line should be used to delimit the extent of private ownership in every instance. Where the coastline is relatively straight, the mean high water line is generally the proper coastal boundary. Where the coastline is indented, however, as in the case of tidal basins and rivers, one may: (1) follow the sinuosities of the shore inside the coastal indentation as far as the tide ebbs and flows; (2) follow the sinuosities of the shore inside the coastal indentation as far as the tidally affected waters are navigable; or (3) draw a straight line across the mouths of the coastal indentation and treat it as a separate waterbody for title purposes.[170] A state's choice of one particular approach over another seemingly depends on the nature of its test of navigability for title purposes.

In England, where ownership of submerged lands was associated with the ebb and flow of the tides[171] rather than upon actual navigability, tidally affected rivers and basins were called "arms and creeks of the sea" and title to their submerged beds was vested prima facie in the King.[172] In his treatise, *De Jure Maris,* Lord Hale declared "[T]hat is called an arm of the sea where the sea flows and reflows, and so far only as the sea so flows and reflows."[173] However, tidal waters could be fresh as well as salt, as for example, where fresh water was backed up because of the action of the salt water. According to

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169. *But see* Part IV C(2)(c) *infra.*

170. In order to locate exactly where a tributary waterway joins the principal waterway, one must consider the physical configuration of the tributary waterway at its terminus. The headland-to-headland approach, which is based on this principle, has been applied in international law to determine the limits of inland waters. S. SWARZTRAUBER, THE THREE-MILE LIMIT OF THE TERRITORIAL SEAS 224-25 (1972). The headland-to-headland approach also may be used in connection with the Submerged Lands Act. *See generally* Shalowitz, *Boundary Problems Raised by the Submerged Lands Act,* 54 COLUM. L. REV. 1021 (1954).

A headland is the apex of a salient of the coast, the farthest point at which a portion of land extends into the water, or the point on the shore at which there is an appreciable change in direction of the general trend of the coast. In theory, each terminus of the headland-to-headland line is taken as a point at the outermost extension of the headland from which it is drawn. 1 A. SHALOWITZ, *supra* note 5, at 63-65.

171. *See* discussion in Part III B(1)(a) *supra.*

172. 1 H. FARNHAM, *supra* note 8, §§ 37-40.

173. S. MOORE, *supra* note 28, at 378.

Lord Hale: "But if it seems that although the water be fresh at high water, yet the denomination of an arm of the sea continues if it flows and reflows as in *Thames*."[174] It remains the rule in England,[175] as well as in some American jurisdictions,[176] that where fresh waters are subject to tidal influence, the land beneath such waters is owned by the sovereign.

In America, some states at first adopted a test of navigability based on whether the tide ebbed and flowed in a particular water course.[177] Eventually, however, the so-called ebb-and-flow test was displaced by the concept of "navigability in fact."[178] In the nineteenth century the United States Supreme Court utilized the navigability-in-fact standard for purposes of defining the scope of federal regulatory power.[179] The Court in *The Daniel Ball* set forth the following definition of navigability in fact:

> Those rivers must be regarded as public navigable rivers in law which are navigable in fact. And they are navigable in fact when they are used, or are susceptible of being used, in their ordinary condition, as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water.[180]

At the present time it is well settled that the federal test of navigability for purposes of both admiralty[181] and commerce clause[182] jurisdiction is that of navigability in fact.[183]

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174. *Id.*

175. Malcomson v. O'Dea, 11 Eng. Rep. 1155 (1863); Rex v. Smith, 99 Eng. Rep. 283 (K.B. 1780).

176. Peyroux v. Howard, 32 U.S. (7 Pet.) 324, 343 (1833) (admiralty jurisdiction); Heckman v. Swett, 99 Cal. 303, 307, 33 P. 1099, 1101 (1893); Simmons v. French, 25 Conn. 346, 352 (1856); Stone v. City of Augusta, 46 Me. 127, 137 (1858); Commonwealth v. Vincent, 108 Mass. 441, 447 (1871); Attorney General v. Woods, 108 Mass. 436, 439 (1871); Gough v. Bell, 21 N.J.L. 156, 160 (Sup. Ct. 1847); People v. Tibbetts, 19 N.Y. 523, 528 (1859); Tinicum Fishing Co. v. Carter, 61 Pa. 21, 30 (1869); 1 H. FARNHAM, *supra* note 8, § 38, at 179; J. GOULD, *supra* note 30, § 44, at 104-05. *But see* Morgan v. Negodich, 40 La. Ann. 246, 3 So. 636 (1887).

177. Palmer v. Mulligan, 3 Cai. R. 307 (N.Y. Ct. App. 1805).

178. Young v. Harrison, 6 Ga. 130 (1849); Spring v. Russell, 7 Me. 273 (1831); Wilson v. Forbes, 13 N.C. 30 (1830) (per curiam); Carson v. Blazer, 2 Binn. 475 (Pa. 1810).

179. The Montello, 87 U.S. (20 Wall.) 430 (1874); The Daniel Ball, 77 U.S. (10 Wall.) 557 (1870); The Propeller Genessee Chief v. Fitzhugh, 53 U.S. (12 How.) 443 (1851).

180. 77 U.S. (10 Wall.) 557, 563 (1870).

181. 1 BENEDICT ON ADMIRALTY § 141 (7th ed. 1974).

182. *See generally* Bartke, *The Navigation Servitude and Just Compensation—Struggle for a Doctrine*, 48 ORE. L. REV. 1 (1968); Hanks, *Federal-State Rights and Relations*, in 2 WATERS AND WATER RIGHTS § 100.1 (R. Clark ed. 1967).

183. The United States Supreme Court in United States v. Appalachian Elec. Power Co., 311 U.S. 377 (1940), considered a nonnavigable watercourse to be navigable-in-fact for regulatory purposes if it could be made navigable by reasonable improvements.

Although most of the states rejected the ebb-and-flow test for regulatory purposes in favor of navigability in fact, it is often unclear which test of navigability applied for purposes of determining title to submerged lands.[184] In some jurisdictions state ownership extends to all lands subject to the tide, while in others such rights depend upon the actual navigability of the watercourse. In some of these latter states, however, a finding of tidal effect raises a presumption of navigability and state ownership.

(i) The ebb-and-flow test

In Louisiana, Maryland, New Jersey, New York and Texas state ownership of the bed extends to all lands affected by the ebb and flow of the tides.

The Lousiana test for title to tidal watercourses was articulated in *State v. Bayou Johnson Oyster Co.*[185] The Lousiana Supreme Court declared that the State acquired the soil beneath "the waters of intercommunicating sounds, bayous, creeks, channels, lakes, bays, coves, and inlets, bordering upon the Gulf of Mexico and within the ebb and flow of the tide"[186] upon admission to the Union. The case involved the State's claim to certain sounds and bayous also claimed by the defendant through a grant of swamp and overflowed land. The *Bayou Johnson* case appeared to be a clear statement of the ebb-and-flow for title test.[187] More recently, however, the Louisiana courts have considered navigability in fact as well as the ebb and flow of the tides.[188] In *Terrebonne Parish School Board v. Texaco, Inc.*,[189] which involved mineral leases for the beds of Mud Hole Bay and Mud Hole Bayou, the basic issue was whether either waterbody had been navigable at the time of Louisiana's admission to the Union.[190] Although evidence was

184. *See* Leighty, *The Source and Scope of Public and Private Rights in Navigable Waters*, 5 LAND & WATER L. REV. 391, 392-93 (1970). Confusion in the use of the various definitions of "navigability" and "navigable" has been a characteristic of the development of water law in this country. *See* Johnson & Austin, *Recreational Rights and Titles to Beds on Western Lakes and Streams*, 7 NATURAL RESOURCES J. 1, 4 (1967).

185. 130 La. 604, 58 So. 405 (1912).

186. *Id.* at 611, 58 So. at 407.

187. *Contra*, State *ex rel.* Bd. of Comm'rs v. Capdeville, 146 La. 94, 83 So. 421 (1919); *see* Burns v. Crescent Gun & Rod Club, 116 La. 1038, 41 So. 249 (1906) wherein navigability in fact is discussed in relation to private ownership of a bayou affected by the ebb and flow of the tide.

188. D'Albora v. Garcia, 144 So. 2d 911 (La. Cir. Ct. App. 1962).

189. 178 So. 2d 428 (La. Cir. Ct. App.), *cert. denied*, 248 La. 465, 179 So. 2d 640 (1965), *cert. denied*, 384 U.S. 950 (1966).

190. *Id.* at 435.

presented that the waters of the bay and bayou fluctuated with the tides the court also considered evidence of use of the waters by commercial fishermen and moonshine whiskey runners (whose vessels were reported to draw five feet).[191] The court found the waters navigable, stating: "Our Courts have repeatedly held that rivers or bodies of water, which are navigable in fact, are navigable in law."[192] Thus the land beneath tidal watercourses in Lousiana may be sovereignty land if the tide ebbs and flows; however, the navigability of the watercourse may also be taken into account.

The Maryland court had called its ebb-and-flow test[193] and the federal navigable-in-fact test "functionally complimentary,"[194] and a suggestion of considering the navigability as well as the ebb and flow of the water has entered Maryland decisions involving title to submerged lands.[195] However, a federal court has noted that Maryland has not yet found it necessary to abandon its "ancient" standard,[196] and the ebb-and-flow test, since waters which have been considered have been both subject to the ebb and flow of tides and navigable in fact.

Mississippi courts have consistently held that the state as sovereign owns all land "in the beds of all its shores, arms and inlets of the sea, wherever the tide ebbs and flows."[197] The phrase navigable river is held in Mississippi to be a technical term of common law. "A river is navigable in the technical sense, as high up from its mouth as the tide flows. . . . Above that it may be a common highway, subject to the use of the public for navigation . . . , but it is not technically a navigable river."[198] In fact, a riparian owner on the Mississippi River above where the tide ebbs and flows owns the title to the bed of the river to the center of the stream.[199] Mississippi courts have also consistently held that lands under navigable waters cannot be conveyed

191. *Id.* at 433. Evidence was also admitted by an expert in micro-paleontology and ecology, by an expert in geology and geomorphology and by an expert geochemist with experience in the use of Carbon 14 dating methods. *Id.* at 434.

192. *Id.* at 436.

193. Wagner v. City of Baltimore, 210 Md. 615, 624, 124 A.2d 815, 819-20 (1956); Clark v. Todd, 192 Md. 487, 492, 64 A.2d 547, 549 (1949); Toy v. Atlantic Gulf & Pac. Co., 176 Md. 197, 206, 4 A.2d 757, 762 (1939).

194. Owen v. Hubbard, 260 Md. 146, 152 n.1, 271 A.2d 672, 676 n.1 (1970).

195. *See* Van Ruymbeke v. Patapsco Indus. Park, 261 Md. 470, 276 A.2d 61 (1971); Green v. Eldridge, 230 Md. 441, 443-47, 187 A.2d 674, 676-77 (1963).

196. United States v. 222.0 Acres of Land, 306 F. Supp. 138 (D. Md. 1969).

197. State *ex rel.* Rice v. Stewart, 184 Miss. 202, 230, 184 So. 44, 50 (1938); *accord,* Rouse v. Saucier's Heirs, 166 Miss. 704, 713, 146 So. 291, 291-92 (1933); Money v. Wood, 152 Miss. 17, 28, 118 So. 357, 359 (1928).

198. State *ex rel.* Rice v. Stewart, 184 Miss. 202, 225, 184 So. 44, 47 (1938).

199. The Steamboat Magnolia v. Marshall, 39 Miss. 109 (1860).

for private purposes, since the land is held by the State in trust for the public.[200] The Mississippi court did uphold the sale of tidelands filled in by the State for a public park which was to include private building lots in *Treuting v. Bridge & Park Commission.*[201] However, the court explained in *International Paper Co. v. Mississippi State Highway Department*[202] that such a sale must be for an overall public purpose. In *International Paper* the State court affirmed that the state owns all lands below the high water mark subject only to the public interest in navigation and the power of Congress over navigation.[203]

In New Jersey the ebb and flow of the tides in a stream determines public ownership. The navigability test for public ownership was specifically rejected in *Schultz v. Wilson*[204] as lacking in certainty or accuracy.[205] Moreover, in *Yara Engineering Corp. v. New Jersey Turnpike Authority*[206] the bed of a small tidal creek which was "not a navigable stream or suitable or used for fishery" was declared to be state sovereignty land. The creek was entirely within a 12.9 acre tract of land and at low tide contained no water except fresh water drained from higher ground,[207] yet the creek did meet the test of ebb and flow with the tides.[208] New Jersey's claim to tidally affected creeks and estuaries is consistent with its expressed claim to all "tide-flowed lands up to the high-water mark."[209]

The New York rule as to title of tidal waters was set forth in *Fulton Light, Heat & Power Co. v. State.*[210] The case, which involved title to the bed of a fresh water stream, held that "[i]n law, the term 'navigable river' has received a technical application to rivers, or arms of the sea, in which the tide ebbs and flows."[211] At common law the title to the beds of tidal streams was fixed in the Sovereign. Since New York had adopted the common law, the Oswego, being nontidal, was

200. State v. Hardee, 259 S.C. 535, 193 S.E.2d 497 (1972).
201. 199 So. 2d 627 (Miss. 1967).
202. 271 So. 2d 395 (Miss. 1972).
203. *Id.* at 397-98.
204. 44 N.J. Super. 591, 131 A.2d 415 (App. Div.), *cert. denied,* 24 N.J. 546, 133 A.2d 395 (1957).
205. "The navigability test could only be made certain by the adoption of arbitrary standards, such as depth of water, tonnage and the like, which would probably vary from stream to stream." *Id.* at 604, 131 A.2d at 423.
206. 49 N.J. Super. 603, 141 A.2d 66 (App. Div. 1958) (per curiam).
207. *Id.* at 604-05, 141 A.2d at 66-67.
208. *Id.* at 606, 141 A.2d at 67.
209. O'Neill v. State Highway Dep't, 50 N.J. 307, 323, 235 A.2d 1, 9 (1967).
210. 200 N.Y. 400, 94 N.E. 199 (1911).
211. *Id.* at 412, 94 N.E. at 202.

nonnavigable for title purposes and subject to private ownership.[212] Discussions of navigability by New York courts after *Fulton* center on the obstruction of particular waters for navigation and the right of the public to so navigate.[213] There are inconsistencies in New York lower court decisions, however, as to whether navigability in fact must be considered to determine the ownership of lands under tidal waters.[214]

In Texas water law has been shaped by Spanish civil law as well as by the English common law. In 1859 in *City of Galveston v. Menard*[215] the Texas Supreme Court determined that ownership of land beneath Galveston Bay, where the tide ebbed and flowed, was vested in the state.[216] More recently in *Lorino v. Crawford Packing Co.*[217] the court stated: "The bays, inlets, and other waters along the Gulf Coast which are subject to the ebb and flow of the tide of the Gulf of Mexico are defined as navigable waters."[218] Further, in the opinion of the court, the lands under such waters were owned by the State and constituted public property held in trust for the people.[219] Navigability of streams for title purposes in Texas has been defined by legislation[220] that has had the effect of perpetuating the Mexican and Spanish civil law rule that ownership of all streams remains in the sovereign.[221] Thus, though Texas law uses the term navigability when considering ownership of streams, it appears that the beds of tidal streams in Texas are state owned, whether navigable in fact or not.

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212. *Id.* at 415-16, 94 N.E. at 203.

213. *E.g.*, Van Cortlandt v. New York Cent. R.R., 265 N.Y. 249, 192 N.E. 401 (1934) (action for nuisance for obstructing a river); People *ex rel.* Lehigh Valley Ry. v. State Tax Comm'n, 247 N.Y. 9, 159 N.E. 703 (1928) (railroad bridge allegedly obstructing navigation on the Oswego River); People v. Delaware & Hudson Co., 213 N.Y. 194, 107 N.E. 506 (1914) (alleged public nuisance obstructing a navigable-for-title stream); Fairchild v. Kraemer, 11 App. Div. 2d 232, 204 N.Y.S.2d 823 (1960) (right of public to anchor in a privately owned tidal basin).

214. *Compare* State v. Bishop, 75 Misc. 2d 787, 348 N.Y.S.2d 990 (Sup. Ct. 1973) (the state's claim to tidal marshland below the mean high water line depended upon the navigability in fact of the tidal marsh), *with In re* Schurz (Harding) Ave., 278 App. Div. 309, 104 N.Y.S.2d 395 (1951), *rev'd per curiam*, 2 N.Y.2d 859, 161 N.Y.S.2d 124, 141 N.E.2d 615 (1957) (all land below high water mark was sovereignty land, not just channel of stream).

215. 23 Tex. 349 (1859).

216. *Id.* at 396.

217. 142 Tex. 51, 175 S.W.2d 410 (1943).

218. *Id.* at 55, 175 S.W.2d at 413.

219. *Id.* at 56, 175 S.W.2d at 413.

220. TEX. REV. CIV. STAT. art. 5302 (1962). "All streams so far as they retain an average width of thirty feet from the mouth up shall be considered navigable streams . . . ."

221. *See* Heard v. Town of Refugio, 129 Tex. 349, 103 S.W.2d 728 (1937); State v. Bradford, 121 Tex. 515, 50 S.W.2d 1065 (1932).

(ii) The navigability-in-fact test

Many states have rejected the ebb-and-flow test and substituted tests of navigability similar to the federal navigability-for-title test. In California, Connecticut, Florida, North Carolina and Washington these navigability tests have been applied to tidal watercourses, although not always in the context of title determination.

Ownership of the beds of tidal watercourses was determined by the navigability of the creeks or estuaries in early California cases. In *Bolsa Land Co. v. Burdick*[222] and *Forestier v. Johnson*[223] the question of private ownership was discussed as it related to the public right to hunt or fish on certain waters. *Bolsa* involved an estuary and its tributary tidal sloughs. The estuary, however, had been dammed, thereby eliminating the tidal effect, and the court permitted the exclusion of the public, thus recognizing private ownership of the bed of the estuary.[224] In *Forestier* however, the court upheld the public right to fish and hunt on the waters of a tidally-affected 302-acre bay,[225] but also recognized private ownership of the land beneath the bay.[226] The test for public ownership of a tidal watercourse was not, then, the ebb-and-flow test.[227] One test used by an intermediate court was "[a stream's] practical utility for navigation during ordinary stages of water at any particular time."[228] *Bohn v. Albertson*,[229] also an intermediate court decision, discussed the federal navigability for title test,[230] concluding that "[n]avigability is largely a question of fact."[231] The court then examined the "pleasure boat" navigability test[232] and applied that test to the waters involved to find them navigable.[233] However, title to the land remained in the private owner because his land had been submerged by avulsion.[234] To be considered sovereignty land in Cali-

222. 151 Cal. 254, 90 P. 532 (1907).
223. 164 Cal. 24, 127 P. 156 (1912).
224. 151 Cal. at 260, 90 P. at 534.
225. 164 Cal. at 33-34, 127 P. at 160.
226. *Id.*
227. This test had been rejected earlier in Churchill Co. v. Kingsbury, 178 Cal. 554, 558, 174 P. 329, 330 (1918).
228. City & County of San Francisco v. Main, 23 Cal. App. 86, 137 P. 281 (1st Dist. Ct. App. 1913).
229. 107 Cal. App. 2d 738, 238 P.2d 128 (1st Dist. Ct. App. 1951).
230. *Id.* at —, 238 P.2d at 131.
231. *Id.*
232. *Id.* at —, 238 P.2d at 132-33. See Johnson & Austin, *supra* note 184, at 36-44 for a discussion of the pleasure boat test of navigability for privately owned bodies of water.
233. 107 Cal. App. 2d at —, 238 P.2d at 135.
234. *Id.*

fornia, therefore, lands beneath tidal watercourses must underlie navigable waters, even if they are only navigable for recreational purposes.

Connecticut has also asserted state ownership of the soil between the high and low-water marks only under navigable waters.[235] The test of navigable waters in Connecticut was stated in *Edward Balf Co. v. Hartford Electric Light Co.*,[236] a case concerning an inland river. This test is essentially the federal test for title, but as early as 1850 Connecticut had declared a tidal cove that was capable of floating only a "*fish boat* or skiff" non-navigable.[237] One can infer from these cases that Connecticut considers the test for state ownership in navigable waters to be navigability, not the ebb and flow of the tides.

In Florida sovereignty lands are defined as those beneath navigable waters, including the shore or the space between the high and low-water marks.[238] *Clement v. Watson*,[239] an early Florida case, involved an assault arising from an alleged trespass in waters affected by the ebb and flow of ocean tides.[240] The court stated that "[w]aters are not under our law regarded as navigable merely because they are affected by the tides"[241] and found the lands beneath the waters of the Watson cove to be privately owned.[242] The court did not establish a strict test for navigability, but listed size, depth and "other conditions" as considerations for determining whether waters were navigable "for useful public purpose."[243] Although the Florida courts have not cited *United States v. Holt State Bank*[244] for navigability for title, later cases have linked the determination of navigability to commerce, thus appearing to follow the federal test.[245] Inferentially, based on *Clement v. Watson*, public or private ownership of a tidal watercourse in Florida depends upon the navigability for commerce of the watercourse.[246]

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235. Bloom v. Water Resources Comm'n, 157 Conn. 528, 533, 254 A.2d 884, 887 (1969); Rochester v. Barney, 117 Conn. 462, 169 A. 45 (1933).
236. 106 Conn. 315, 138 A. 122 (1927).
237. Town of Wethersfield v. Humphrey, 20 Conn. 218 (1850).
238. State v. Black River Phosphate Co., 32 Fla. 82, 106, 13 So. 640, 648 (1893).
239. 63 Fla. 109, 58 So. 25 (1912).
240. *Id.* at 110-11, 58 So. at 26.
241. *Id.* at 112, 58 So. at 26.
242. *Id.* at 113, 58 So. at 27.
243. *Id.* at 112, 58 So. at 26.
244. 270 U.S. 49 (1926). *See* text accompanying notes 280-82 *infra.*
245. Baker v. State, 87 So. 2d 497, 498 (Fla. 1956); Lopez v. Smith, 145 So. 2d 509 (Fla. Dist. Ct. App. 1962).
246. *See* Tarpon Springs v. Smith, 81 Fla. 479, 498, 88 So. 613, 619 (1921); Lopez v. Smith, 109 So. 2d 176 (Fla. Dist. Ct. App. 1959).

North Carolina rejected the ebb-and-flow test in the nineteenth century.[247] Public waters for title purposes was defined by the courts at that time as those waters which provided common passage for sea vessels.[248] The sea vessels test was replaced in 1952 by the navigability-in-fact test.[249] One federal court interpreted navigability in fact broadly to include a tidal marsh which could only be crossed by a small boat at high tide if the northeasterly wind was not steady.[250] However, the North Carolina Supreme Court has since defined navigable waters as those which in their ordinary state can be used for "water commerce, trade and travel."[251] One commentator argues that North Carolina is still developing its navigability test and may return to the ebb-and-flow test to protect the foreshore from private appropriation.[252]

Under the Washington Constitution the State owns the beds and shores of all navigable waters up to the high water mark.[253] In *Wilson v. Pickett*,[254] the Washington Supreme Court determined the ownership of the bed of a tidal river. The only evidence of navigability of the river was that various tug boats and other small craft had towed logs along its banks.[255] The Washington court declared: " 'We do not believe, however, that the said constitutional provision was intended to include streams of the character of this one, but only such as are navigable for general commercial purposes.' "[256] The private landowner, in the opinion of the Court, held title to the bed of the stream subject to the right of the public to float logs.[257] More recently, in *Strand v. State*,[258] the Washington court, citing *United States v. Utah*,[259] determined the navigability of a tidal slough by considering the capability of the creek for carrying commerce.[260] Since the slough could be used only at high tide and then only for a "boat transporting fish," the slough

247. Wilson v. Forbes, 13 N.C. 30 (1828).
248. Home Real Estate Loan & Ins. Co. v. Parmele, 214 N.C. 63, 197 S.E. 714 (1938); State v. Glen, 52 N.C. 321 (1859). *See* Rice, *Estaurine Land of North Carolina: Legal Aspect of Ownership, Use and Control*, 46 N.C.L. REV. 779, 796-99 (1968).
249. Resort Dev. Co. v. Parmele, 245 N.C. 689, 71 S.E.2d 474 (1952).
250. Swan Island Club v. White, 114 F. Supp. 95 (E.D.N.C. 1953).
251. Parmele v. Eaton, 240 N.C. 539, 548, 83 S.E.2d 93, 99 (1954).
252. Note, *Defining Navigable Waters and the Application of the Public Trust Doctrine in North Carolina: A History and Analysis*, 49 N.C.L. REV. 888, 904 (1971).
253. WASH. CONST. art. 17, § 1.
254. 79 Wash. 89, 139 P. 754 (1914).
255. *Id.* at 90, 139 P. at 755.
256. *Id.* at 91, 139 P. at 755, *quoting* Watkins v. Dorris, 24 Wash. 636, 644, 64 P. 840, 843 (1901).
257. 79 Wash. at 90, 139 P. at 755.
258. 16 Wash. 2d 107, 132 P.2d 1011 (1943).
259. 283 U.S. 64 (1931).
260. 16 Wash. 2d at 125, 132 P.2d at 1019.

was found to be nonnavigable.[261]

Alabama, Oregon and South Carolina find tidal watercourses prima facie navigable and thus presume the land beneath the watercourses to be sovereign land, but this presumption of state ownership *may* be rebutted by a finding of non-navigability.

It has been stated by the Alabama Supreme Court that all tidal navigable streams are prima facie public and navigable.[262] An early decision, however, stated that the ebb and flow of the tide "only operates to impress, *prima facie*, the character of being public and navigable, and to place the *onus* of proof on the party affirming the contrary."[263] In Alabama, navigability is a question of fact,[264] and navigability has been defined in relationship to commercial uses of the water.[265]

Oregon recognizes the federal test for navigable inland waters,[266] but considers streams in which the tide ebbs and flows prima facie navigable.[267] In *Guilliams v. Beaver Lake Club*[268] the Oregon court classified streams and bodies of water into four categories.[269] Those in which the tide ebbed and flowed were "technically denominated navigable, in which class the sovereign is the owner of the soil constituting the bed of the stream."[270]

South Carolina also considers tidal watercourses prima facie navigable. In 1884 in *State v. Pacific Guano Co.*[271] the South Carolina court appeared to adopt the tidal test for ownership purposes, but modified the ebb-and-flow test by allowing the presumption of navigability and State ownership to be rebutted by showing that "conditions and objects of navigation do not exist."[272] South Carolina continues to use

261. *Id.* at 125-28, 132 P.2d at 1019-21.
262. Sayre v. Dickerson, 278 Ala. 477, 491, 179 So. 2d 57, 70 (1965).
263. Sullivan v. Spotswood, 82 Ala. 163, 166, 2 So. 716, 717 (1887).
264. United States v. Property on Pinto Island, 74 F. Supp. 92, 104 (S.D. Ala. 1947); *see* Walker v. Allen, 72 Ala. 456, 458 (1882).
265. Sullivan v. Spotswood, 82 Ala. 163, 2 So. 716 (1887). For a general discussion of Alabama title cases involving water boundaries see Cohen, *Water Law in Alabama—A Comparative Survey*, 24 ALA. L. REV. 453, 468-72 (1972).
266. *See* Luscher v. Reynolds, 153 Ore. 625, 56 P.2d 1158 (1936).
267. *Id.* at 636, 56 P.2d at 1162.
268. 90 Ore. 13, 175 P. 437 (1918).
269. The four categories were (1) those waters in which the tide ebbs and flows; (2) those waters which are navigable in fact for boats, vessels or lighters; (3) streams which are not navigable for any purpose; and (4) the larger rivers which were capable of carrying a great volume of commerce. *Id.* at 19, 175 P. at 439.
270. *Id.*
271. 22 S.C. 50 (1884).
272. *Id.* at 56.

the term "navigable" in relationship to tidal streams, without defining the term.[273]

(iii) The federal test of navigability for title purposes

The various state tests of navigability for title purposes have been reviewed; however, there remains a question of whether federal, rather than state law, should control the legal test of ownership to the beds of tidally-affected watercourses.

The thirteen original states and Texas hold title to land underlying navigable streams and tidewaters by virtue of their sovereignty,[274] while other states acquired it with the grant of statehood.[275] Uncertainties caused by the *Tidelands Decisions*[276] were resolved by the Submerged Land Act,[277] which reaffirmed state ownership of lands under both inland navigable waters and tidewaters.[278]

Whether title to the bed of a particular inland stream passed to the state on statehood is considered to be a question of federal law.[279] The test to determine whether a stream is navigable for title purposes under federal law was announced in *United States v. Holt State Bank*,[280] in which the Court declared:

> [S]treams or lakes which are navigable in fact must be regarded as navigable in law; . . . they are navigable in fact when they are used or are susceptible of being used, in their natural and ordinary condition, as highways for commerce, over which trade and travel are or may be conducted in customary modes of trade and travel on water. . . .[281]

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273. *E.g.*, State v. Hardee, 259 S.C. 535, 193 S.E.2d 497 (1972) (lower court's finding of fact as to navigability upheld). *See generally* Clineburg & Krahmer, *The Law Pertaining to Estuarine Lands in South Carolina*, 23 S.C.L. REV. 7 (1971).

274. *See generally* Leighty, *supra* note 184.

275. Pollard's Lessee v. Hagan, 44 U.S. (3 How.) 212 (1845).

276. United States v. Texas, 339 U.S. 707 (1950); United States v. Louisiana, 339 U.S. 699 (1950); United States v. California, 332 U.S. 19 (1947). Although the holding in these opinions concerned the state ownership of the marginal sea beyond the low water mark, the states were apprehensive about their titles to other submerged lands. Leighty, *supra* note 184, at 424. *See* discussion of federal-state coastal boundaries in Part III C *infra*.

277. 43 U.S.C. §§ 1301-15, 1331-43 (1970).

278. Tidelands in this sense applies to the foreshore or the land below the high and low water marks. Marks v. Whitney, 6 Cal. 3d 251, 491 P.2d 374, 98 Cal. Rptr. 790 (1971); People v. Hecker, 179 Cal. App. 2d 823, —, 4 Cal. Rptr. 334, 341 (2d Dist. Ct. App. 1960); Apalachicola Land & Dev. Co. v. McRae, 86 Fla. 393, 453, 98 So. 505, 525 (1923); Bay City Land Co. v. Craig, 72 Ore. 31, 33, 143 P. 911, 912 (1914).

279. United States v. Utah, 283 U.S. 64 (1931); United States v. Holt State Bank, 270 U.S. 49 (1926); Brewer-Elliott Oil & Gas Co. v. United States, 260 U.S. 77 (1922).

280. 270 U.S. 49 (1926).

281. *Id.* at 56.

In the tidelands the state can claim title to submerged lands as far shoreward as the mean high water line.[282] The issue, therefore, is whether the state owns beds under all tidally affected watercourses, or whether title depends on the actual navigability of these waters as suggested by the *Holt State Bank* case. The *Holt* case, however, involved a fresh water lake rather than tidally-affected waters; therefore, even if the federal navigability for title test is deemed binding on the states generally, it remains unclear whether the *Holt* case is applicable to tidal waters.

The only relevant federal authority on this issue appears to be *Knight v. United Land Association.*[283] The case involved title to the partially filled bed of Mission Creek that emptied into San Francisco Bay. A government survey that had followed the high water line up Mission Creek had been set aside by the federal government in favor of a survey from headland to headland of the creek. It was not clear from the opinion whether the creek had been navigable in fact before the filling. In discussing the conclusiveness of the government survey, Justice Field, in a concurring opinion, stated that the established rule was to survey from headland to headland a smaller body of water at its intersection with a larger body of water.[284] This dictum suggests that under federal law the states' title to submerged land may depend on navigability in fact. Nevertheless, the issue remains very much of an open question at this time.

(b) Obstructed entrances to tidal basins

The existence of a berm or other obstruction cutting off or partially blocking the entrance to a tidal cove or basin may create serious practical problems with respect to the location of the boundary line between public and private land. Turning first to berms, a berm of this type is a ridge, built up by wave action or the force of the tides and is often located along the outer edge of vegetation. Such berms may be an inch to a foot higher than the land behind them. They restrict the flow of normal high water and may act as dams, trapping fresh water run off or extreme high tides behind them.[285]

The physical characteristics of a berm or other obstruction in relation to the land behind it may vary in a number of ways. First, the obstruction may completely block off the entrance to a tidally affected

282. *E.g.*, Borax Consol. Ltd. v. City of Los Angeles, 296 U.S. 1015 (1935).
283. 142 U.S. 161 (1891).
284. *Id.* at 207.
285. Guth, *supra* note 6, at 7.

cove or basin. There are a number of other possibilities, however. The berm may be incomplete, with one or more openings through which navigation is possible, or it may simply block off direct access to a part of a cove or basin, navigation behind it being possible. The opening through the berm may be at the mouth of a tidal watercourse that is navigable for a distance beyond the berm. The watercourse may run through a basin or estuary, the sides of which may be overflowed by tidally affected but non-navigable waters, navigability being prevented either by vegetation or the shallowness of the basin or estuary beyond the channel of the watercourse. These situations may have different legal consequences insofar as ownership of the bottom land is concerned.

To begin with, a distinction must be made between jurisdictions that equate public ownership with the ebb and flow of the tide[286] and those that use "navigability in fact" as the test for title to overflowed lands.[287] In the former group, it would seem that all of the overflowed land within the range of the tide up to the mean high water line would be sovereignty land, no matter which of the above fact categories was involved.[288] More difficult conceptual problems arise in the navigability-in-fact jurisdictions. In such a jurisdiction, the first example (that of the berm which completely encloses the mouth of a cove or basin thus making it non-navigable due to lack of access) should result in title being found to be in the upland owner, even though the water may be deep enough for navigation inside the berm. Such a result was indicated by the Florida case of *Clement v. Watson.*[289] The case was not a title case as such, but rather an action for damages for assault and battery in which the court upheld the right of the defendant to evict as a trespasser one who entered the cove inside the berm line.[290] An

286. *See* Part III B(2)(a)(i) *supra.*

287. *See* Part III B(2)(a)(ii) *supra.*

288. *E.g.*, Toy v. Atlantic Gulf & Pac. Co., 176 Md. 197, 4 A.2d 757 (1939); Linthicum v. Shipley, 140 Md. 96, 116 A. 871 (1922); Schultz v. Wilson, 44 N.J. Super. 591, 131 A.2d 415 (App. Div. 1954), *cert. denied*, 24 N.J. 546, 133 A.2d 395 (1957).

289. 63 Fla. 109, 58 So. 25 (1912). *See also* Fisher v. Barber, 21 S.W.2d 569 (Tex. Civ. App. 1929) (artificial channel cut in bar blocking tide waters); Guilliams v. Beaver Lake Club, 90 Ore. 13, 175 P. 437 (1918) (sand thrown up by the ocean had caused a small stream to become a lagoon). *But see* Sollers v. Sollers, 77 Md. 148, 26 A. 188 (1893), which involved a fact situation almost identical to *Clement v. Watson.* In an action in trespass, private ownership of a tidal cove connected to the ocean by an artificial channel was claimed. The court determined that the cove was an arm of the sea; hence title to the soil was vested in the state, and the action for trespass failed. Maryland is an "ebb and flow" state, which may explain the contrast between *Clement* and *Sollers.*

290. 63 Fla. at 110-111, 58 So. at 26.

artificial opening through the berm by the landowner that made navigation possible did not affect the ownership of the submerged land inside the berm that remained private property.[291] This result is supported by the Model Coastal Mapping Act, which provides optional language codifying this position for navigability-for-title jurisdictions.[292]

If there are one or more openings in the berm, making it possible to navigate inside the berm line, arguably the title of the sovereign should extend to the mean high water line of the bay or cove even though this line is considerably inland of the area that can be navigated.[293] Conceptually, this situation would seem to parallel that of an open beach which happens to have a sand bar or offshore islands partially blocking navigation, since it is possible to navigate inside these partially obstructing islands or sand bars. In navigability-in-fact jurisdictions the boundary between sovereignty lands and uplands along the beach should be the mean high water line even though one cannot navigate all the way to that line.[294]

If the area inside the berm is not navigable in fact because the openings in it are too small or too shallow, it would seem to follow that the berm would be the boundary line, despite such openings.[295]

Suppose that an opening in the berm is made by a tidal watercourse that is navigable inside the berm to a point above the shoreline of the cove or bay. Since it is now possible to navigate inside the berm line, the mean high water line along the shore of the basin should again be the boundary.[296] In addition, public ownership will probably ex-

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291. *Id.* at 113, 58 So. at 27.

292. Model Coastal Mapping Act § 4(1), included in the appendix to this Article [hereinafter cited as Model Act].

293. United States v. Turner, 175 F.2d 644 (5th Cir. 1949) (court held that the shallows of navigable bodies of water are owned by the state whether or not the shallows themselves are actually navigable); Alston v. Limehouse, 60 S.C. 559, 39 S.E. 188 (1901), involved a salt marsh intersected by runnels or drainways to the ocean. The court reasoned that if these drainways were navigable, then the party that claimed ownership of the entire marsh could own only to the highwater marks of the marsh; the land below the high water mark was state-owned. If, however, the drainways were not navigable, then the claimant owned all of the marsh.

294. *See* United States v. Turner, 175 F.2d 644 (5th Cir. 1949); State v. Hardee, 259 S.C. 535, 193 S.E.2d 497 (1972) (State owned to high water line on creek which separated Pawleys Island from mainland).

295. Maddox v. Trustees of Internal Improvement Fund, 37 Fla. Supp. 73 (Cir. Ct. Sarasota County 1970). An oyster bar across the opening of a bayou was dry except at high tide and thus formed a barrier to navigation into the bayou. The court held that the bayou, though below mean high tide, was not sovereignty land.

296. *Cf.* Alston v. Limehouse, 60 S.C. 559, 39 S.E. 188 (1901).

tend up the watercourse so far as it is navigable in fact,[297] unless the jurisdiction is prepared to adopt a "headlands to headlands" rule[298] for such watercourses in cases in which they are navigable for only a short distance inland from the foreshore. If the watercourse is navigable inside the berm, but not all the way to the foreshore, the claim of the sovereign should still extend to the mean high water line, but a more persuasive argument would seem to exist for applying the "headland to headland" rule to the watercourse and drawing a closing line across its mouth at the mean high water line along the shore.[299]

The problem may be further complicated in situations in which berm plus dense vegetation acts as a friction barrier trapping fresh water runoff in such a way that the water, while fresh, varies in elevation with the tide.[300] In most ebb-and-flow jurisdictions,[301] the boundary line is apparently located at the innermost point of tidal fluctuation reached by mean high water even though the water itself is fresh.[302] At least one jurisdiction however, does not recognize a fresh water tidally affected marsh as part of the sea coast, requiring at the very least a combination of salt and fresh water as a basis for the use of the tidal effect to establish public ownership.[303] Whether the same rule would apply in a navigability-in-fact jurisdiction[304] may be more questionable. In such cases the possibility of navigation inside the berm line might be a critical factor in determining ownership inside that line.[305]

The mouth of a cove may be blocked or partially blocked by dense or impenetrable vegetation as well as by berms. If the vegetation is really impenetrable, it might well be equated with a berm that prevents navigation, in effect making the cove a separate non-navigable waterbody and perhaps, therefore, subject to private ownership.[306] If, on the other hand, the vegetation merely obscures entry into the cove, the

297. *See* discussion of navigability-in-fact jurisdictions in Part III B(2)(a)(ii) *supra.*

298. *See* discussion of headland-to-headland rule note 170 *supra.*

299. Toledo Liberal Shooting Co. v. Erie Shooting Club, 90 F. 680 (6th Cir. 1898) involving a navigable channel narrowing into a shallow marsh. The court held that the channel and marsh were subject to private ownership.

300. Guth, *supra* note 6, at 39.

301. *See* discussion of ebb and flow jurisdictions in Part III B(2)(a)(i) *supra.*

302. *See* discussion of whether tidally affected fresh water is an arm of the sea in text accompanying notes 171-76 *supra.*

303. Morgan v. Negodich, 40 La. Ann. 246, 3 So. 636 (1887). The test of ownership of a sea marsh depended upon whether the marsh was a part of the seashore. This in turn depended upon whether the water was a combination of salt and fresh water.

304. *See* Part III B(2)(a)(ii) *supra.*

305. *See* text accompanying notes 293-99 *supra.*

306. *See* text accompanying notes 239-46 *supra.*

situation may be likened to that of the broken berms discussed above,[307] in which the possibility of navigating into the cove beyond its mouth provides an argument for placing the property line at the mean high water line along the shore of the basin rather than across its mouth. Extremely difficult questions of fact may arise in such cases. One may hazard a guess, however, that the situation of complete blockage of such coves will arise relatively infrequently, since tidal water trapped therein tends to keep passageways open for its escape, normally producing the broken berm-type situation. A similar phenomenon may be found with respect to tributary basins on exposed coastlines where one set of tidal forces may tend to deposit sand or other material at the mouth of an inlet, thus reducing it in size or even completely closing it, while currents through the inlet tend to scour away these deposits and keep the channel open.[308]

Finally, there is the problem of artificial changes in basin regimes. Artificial improvements to the entrance of a tidal cove or basin may materially increase the tidal range, resulting in substantial quantities of what was previously upland being submerged at mean high water. Since such a change is avulsive in nature, the property line should not change,[309] but the location of the original line may present extremely difficult problems of proof unless adequate tidal observations are made prior to the improvement.[310] Absent such observations, indirect and less conclusive evidence may have to be relied upon,[311] and the results are likely to be considerably less accurate.[312]

All of this raises very serious policy questions with respect to protection of the environment. The solution of these policy problems, however, does not justify manipulation of the legal rules respecting title to property in coastal areas,[313] especially since there are other effective means of wetland protection.[314]

(c) *Hummocks*

A problem also arises in overflowed areas where small hummocks or hillocks protrude above the mean high tide level. If the area is

307. *See* text accompanying notes 293-99 *supra.*
308. Patton, *Relation of the Tide to Property Boundaries,* in 2 A. SHALOWITZ, *supra* note 5, at 667, 673.
309. *See* text accompanying note 342 *infra.*
310. Patton, *supra* note 308, at 679.
311. Cases cited note 221 *supra.*
312. Patton, *supra* note 308, at 679.
313. Ausness, *supra* note 56, at 412-13.
314. *See* text accompanying notes 393-403 *infra.*

heavily vegetated, as in marsh or mangrove areas where large drainage fields meet the coast, the physical problem of determining exactly what land is above mean high water may become extremely difficult.[315] Even when that problem is solved, proof as to the character of the protruding land, whether swamp and overflowed lands[316] or uplands[317] may present additional problems.

Such distinctions may be important because, if the land in question is covered by water at mean high tide, it will normally be classified as sovereignty land,[318] held in trust by the state for its people.[319] If, on the other hand, it protrudes above mean high water, it will be either swamp and overflowed lands or uplands. If the former, located other than in the original states and not already conveyed by the federal government, it will have passed to the state under the Swamp and Overflowed Lands Act of 1850,[320] but title will not necessarily have lodged in the state, since the ministerial act of conveyance to the state by the Department of the Interior is needed to perfect title in the state.[321] Such conveyances were not automatic, but followed the completion of federal surveys locating and characterizing such lands.[322] Thus, in areas as yet unsurveyed,[323] or where the original federal surveys in meandering the shoreline omitted such lands or where located seaward of this meander line, paper title has remained in the United States, subject to a requirement to patent such lands to the state to perfect the

315. Guth, *supra* note 6.

316. Swamp and overflowed lands are defined as "all legal subdivisions, the greater part whereof is wet and unfit for cultivation . . . ." 43 U.S.C. § 984 (1970). Legal subdivisions within the meaning of the act are 40-acre tracts. Buena Vista County v. Iowa Falls & S.C.R.R., 112 U.S. 165 (1884). Swamp lands were distinguished from overflowed lands in San Francisco Sav. Union v. Irwin, 28 F. 708 (C.C.D. Cal. 1886), *aff'd per curiam*, 136 U.S. 578 (1890). The court stated: "The act of 1850 grants swamp *and* overflowed lands. Swamp lands, as distinguished from overflowed lands, may be considered such as require drainage to fit them for cultivation. Overflowed lands are those which are subject to such periodical or frequent overflows as to require levees or embankments to keep out the water, and render them suitable for cultivation." *Id.* at 712.

317. "Uplands" as used in this context refers to all land that is above mean high water and not classified as swamp and overflowed lands. *See* BUREAU OF LAND MANAGEMENT, U.S. DEP'T OF THE INTERIOR, MANUAL OF INSTRUCTIONS FOR THE SURVEY OF THE PUBLIC LANDS OF THE UNITED STATES 98 (1973).

318. *See* discussion of mean high water line at text accompanying notes 509-18 *infra*.

319. *See* discussion of public trust doctrine in Part II B *supra*.

320. 43 U.S.C. §§ 982-84 (1970).

321. BUREAU OF LAND MANAGEMENT, U.S. DEP'T OF THE INTERIOR, *supra* note 317, at 4.

322. 43 U.S.C. § 983 (1970).

323. BUREAU OF LAND MANAGEMENT, U.S. DEP'T OF THE INTERIOR, *supra* note 317, at 4.

transfer ordered under the Swamp Lands Act of 1850.[324] If, on the other hand, a hummock is classified as uplands—"manoriable"[325] lands capable of cultivation without improvement by drainage—[326] and it has never been conveyed by the United States, title will remain in the federal government, with no obligation to convey it to the state, since it is not swamp land and did not pass under the Swamp and Overflowed Lands Act.[327]

The initial obligation to classify such lands, assuming they have not already been classified, falls upon the Bureau of Land Management of the United States Department of the Interior.[328] When requested by a state,[329] or in its own initiative[330] the Bureau may undertake such classification. In the case of relatively small hummocks surrounded by state sovereignty land below mean high water in densely vegetated areas, the Bureau may decide that such classification is not worth the effort, and refuse to take further action.[331] In the event it does decide to act, however, it should be governed by the *Borax* test,[332] and establish the boundaries of such hummocks at the mean high water line as defined by the Supreme Court in that case. The *Oelschlaeger* approach of using the meander line as a boundary should have no application to this type of problem[333] since rights in the land were not derived from administrative action of the Secretary as in the latter case.

(3) The Ambulatory Nature of Coastal Boundaries

(a) *Common law doctrines*

In most coastal states, tidal boundaries are considered to be ambulatory; that is, the physical location of the mean high (or low) wa-

324. *E.g.*, Rogers Locomotive Mach. Works v. American Emigrant Co., 164 U.S. 559 (1896).

325. Attorney-General v. Chambers, 43 Eng. Rep. 486, 489 (Ch. 1854).

326. The test of fitness for cultivation is whether the land is arable and adapted to raising crops requiring annual tillage. American Emigrant Co. v. Rogers Locomotive Mach. Works, 83 Iowa 613, 50 N.W. 52 (1891), *rev'd on other grounds*, 164 U.S. 559 (1896).

327. 43 U.S.C. §§ 981-86 (1970).

328. BUREAU OF LAND MANAGEMENT, U.S. DEP'T OF THE INTERIOR, *supra* note 317, at 4.

329. BUREAU OF LAND MANAGEMENT, U.S. DEP'T OF THE INTERIOR, APPLICATION FOR SURVEY OF ISLANDS OR OTHER OMITTED PUBLIC LANDS, 43 C.F.R. § 9185.2 (1970).

330. BUREAU OF LAND MANAGEMENT, U.S. DEP'T OF THE INTERIOR, *supra* note 317, at 4.

331. *See, e.g.*, BUREAU OF LAND MANAGEMENT, U.S. DEP'T OF THE INTERIOR, REPORT ON THE PRELIMINARY EXAMINATION OF THE ALLEGED OMITTED LANDS IN T. 46S, R. 24 E., TALLAHASSEE MERIDIAN, FLORIDA SURVEY GROUP 158, at 6 (1974).

332. *See* Part III B(1)(b) *supra*.

333. *See* text accompanying notes 532-35 *infra*.

ter line may shift because of natural or artificial changes in the location of the shoreline. Accordingly, littoral owners may gain or lose land by virtue of accretion, reliction, erosion, or avulsion.

Before discussing the problem of ambulatory versus fixed boundaries, it may be helpful to consider the meaning of a number of terms commonly used in legal discussions of this problem. Accretions or accreted lands consist of additions to the land resulting from the gradual deposit by water of sand, sediment or other material.[334] The term applies to such lands produced along both navigable and non-navigable water.[335] Alluvion is that increase of earth on a shore or bank of a stream or sea, by the force of the water, as by a current or by waves, which is so gradual that no one can judge how much is added at each moment of time.[336] The term "alluvion" is applied to the deposit itself, while accretion denotes the act,[337] but the terms are frequently used synonymously.[338]

Reliction refers to land which formerly was covered by water, but which has become dry land by the imperceptible recession of the water.[339] Although there is a distinction between accretion and reliction, one being the gradual building of the land, and the other the gradual recession of water, the terms are often used interchangeably. The term "accretion" in particular is often used to cover both processes, and generally the law relating to both is the same.[340]

Erosion is the gradual and imperceptible wearing away of land bordering on a body of water by the natural action of the elements.[341] Avulsion is either the sudden and perceptible alteration of the shoreline by action of the water, or a sudden change of the bed or course of a

334. Municipal Liquidators, Inc. v. Tench, 153 So. 2d 728, 730 (Fla. Dist. Ct. App. 1963); Michaelson v. Silver Beach Improvement Ass'n, 342 Mass. 251, 253, 173 N.E.2d 273, 275 (1961); Jones v. Turlington, 243 N.C. 681, 684, 92 S.E.2d 75, 77 (1956); 1 H. FARNHAM, *supra* note 8, § 69.

335. 3 AMERICAN LAW OF PROPERTY § 15.26 (A.J. Casner ed. 1952).

336. St. Clair v. Lovingston, 90 U.S. (23 Wall.) 46, 66 (1874); Humble Oil & Ref. Co. v. Sun Oil Co., 190 F.2d 191, 196 (5th Cir. 1951), *cert. denied*, 342 U.S. 920 (1952).

337. Katz v. Patterson, 135 Ore. 449, 296 P. 54 (1931).

338. *Id.* at 453, 296 P. at 55.

339. Martin v. Busch, 93 Fla. 535, 574, 112 So. 274, 287 (1927); McClure v. Couch, 182 Tenn. 563, 572, 188 S.E.2d 550, 553 (1945); Note, *Avulsion and Accretion—Emphasis Oregon*, 3 WILLAMETTE L.J. 345, 346 (1965).

340. R. BOYER, FLORIDA REAL ESTATE TRANSACTIONS, 206-07 (1959).

341. 3 AMERICAN LAW OF PROPERTY, *supra* note 170; *see* United States v. 461.42 Acres of Land, 222 F. Supp. 55, 56 (N.D. Ohio 1963); 65 C.J.S. *Navigable Waters* § 87a (1966).

stream forming a boundary whereby it abandons its old bed for a new one.[342]

As a general rule, where the shoreline is gradually and imperceptibly changed or shifted by accretion, reliction or erosion, the boundary line is extended or restricted in the same manner. The owner of the littoral property thus acquires title to all additions arising by accretion or reliction, and loses soil that is worn or washed away by erosion.[343] However, any change in the shoreline that takes place suddenly and perceptibly does not result in a change of boundary or ownership.[344] Normally a landowner may not intentionally increase his estate through accretion or reliction by artificial means.[345] However, the littoral owner is usually entitled to additions that result from artificial conditions created by third persons without his consent.[346]

The statutory proposal that accompanies this article in no way attempts to alter the ambulatory nature of tideland boundaries or to limit the corresponding legal doctrines with respect to accretion, reliction, erosion or avulsion.[347] It rejects the notion of the fixed boundary where waterfront property is concerned. The concept of a fixed boundary means that the physical boundaries of littoral property would be permanently fixed as of a specific date without regard to subsequent alteration of the shoreline. Under this approach, therefore, littoral owners could no longer gain land by accretion or reliction, nor could they lose it by means of erosion. As the following discussion will show,

342. Benson v. Morrow, 61 Mo. 345, 352 (1875); State v. Johnson, 278 N.C. 126, 146, 179 S.E.2d 371, 384 (1971); J. GOULD, *supra* note 30, § 158; 65 C.J.S. *Navigable Waters* § 86 (1966).

343. There are said to be four reasons for this principle: (1) *de minimis non curat lex*; (2) he who sustains the burden of losses and of repairs imposed by the contiguity of waters ought to receive whatever benefits they may bring by accretion; (3) it is in the interest of the community that all land have an owner, and for convenience, the riparian is the chosen one; (4) it is necessary to preserve the riparian right of access to water. Board of Trustees of Internal Improvement Trust Fund v. Medeira Beach Nominee, Inc., 272 So. 2d 209, 212-14 (Fla. Dist. Ct. App. 1973).

344. Municipal Liquidators, Inc. v. Tench, 153 So. 2d 728, 730 (Fla. Dist. Ct. App. 1963); Ford v. Turner, 142 So. 2d 335, 342 (Fla. Dist. Ct. App. 1962); Hirt v. Entus, 37 Wash. 2d 418, 224 P.2d 620 (1950); Harper v. Holston, 119 Wash. 436, 441-42, 205 P. 1062, 1064 (1922).

345. Kansas v. Meriwether, 182 F. 457 (8th Cir. 1910); Annot., 91 A.L.R.2d 857 (1963). *See also* United States v. Sunset Cove, Inc., 5 E.R.C. 1023 (D. Ore. 1973). *Contra*, Davis v. Morgan, 228 N.C. 78, 44 S.E.2d 593 (1947).

346. Bonelli Cattle Co. v. Arizona, 414 U.S. 313 (1973); State v. Gill, 259 Ala. 177, 66 So. 2d 141 (1953); Michaelson v. Silver Beach Improvement Ass'n, 342 Mass. 251, 173 N.E.2d 273 (1961); Harrison County v. Guice, 244 Miss. 95, 140 So. 2d 838 (1962); Annot., 134 A.L.R. 467 (1941); F. MALONEY, S. PLAGER & F. BALDWIN, *supra* note 7, § 126.2(b), at 389.

347. Model Act § 4(2); *see* Appendix.

the adoption of a fixed boundary in any coastal state would be extremely difficult since the federal courts have consistently upheld the concept of the ambulatory boundary in cases of littoral property and, as will be seen, this federal law is applicable in those states carved from the federal domain, while state constitutional provisions[348] and reception statutes[349] in the other coastal states would appear to be formidable obstacles to the fixing of such boundaries.[350]

(b) Federal cases

As a general rule the question of title and the rights of riparian and littoral owners to accretion and similar benefits is governed by state law. In federal question cases, however, the courts have held that federal rather than state law applies.[351] The landmark case of *Borax Consolidated Ltd. v. City of Los Angeles*,[352] discussed in detail earlier,[353] interpreted the term "ordinary high water mark" as the mean of all high waters over the 18.6-year tidal cycle and held it to be the tidal boundary where federal law applies. Since the boundary was determined by the intersection of the appropriate tidal datum with the land, an ambulatory rather than a fixed boundary was implied. Of equal importance, however, the *Borax* case set forth the rule that federal law would apply to tidal boundaries in cases involving a federal question. The Court declared:

> The question as to the extent of this federal grant, that is, as to the limit of the land conveyed, or the boundary between upland and the tideland, is necessarily a federal question. It is a question which concerns the validity and effect of an act done by the United States; it involves the ascertainment of the essential basis of a right asserted under federal law.[354]

348. Most states have a provision prohibiting the taking of private property without compensation within their own constitutions. *E.g.*, N.Y. CONST. art. 1, § 7. This provision has been interpreted by one New York court to apply to riparian rights, including the right of access to a stream. Marine Air Ways v. State, 201 Misc. 349, 104 N.Y.S.2d 1964 (Sup. Ct.), *aff'd*, 280 App. Div. 1021, 116 N.Y.S.2d 778 (1951).

349. The common law has been adopted by all states except Louisiana. 15 AM. JUR. 2d *Common Law* § 11 (1964).

350. Fixed boundaries which adversely affect the riparian owner are of doubtful constitutionality; *see* Part II B(2)(b)(ii) *supra*. However, Washington does not recognize the loss by erosion of land abutting lakes, bays or water where granted prior to Washington statehood.

351. Borax Consol. Ltd. v. City of Los Angeles, 296 U.S. 10 (1935); United States v. Holt State Bank, 270 U.S. 49 (1926). *See* Shalowitz, *Tidal Boundaries—The Borax Case Revisited*, 29 SURVEYING & MAPPING 501 (Sept. 1969).

352. 296 U.S. 10 (1935).

353. *See* Part III B(2)(b) *supra*.

354. 296 U.S. at 22.

This principle was subsequently applied to accretion in the *Washington* and *Hughes* cases.

United States v. Washington[355] concerned the ownership of accretions to littoral land owned by the federal government along the coast of Washington. The primary issue in the case was whether state or federal law applied. It was argued that federal law followed the common-law position and recognized the ambulatory nature of tidal boundaries. Under state law, however, the boundary was fixed as of the date of statehood, and subsequent accretions were owned by the state rather than the littoral owner.

The federal court of appeals, reversing the trial court, held that the *Borax* case was controlling and declared that accordingly, federal law would prevail over state law. The court stated that while *Borax* had not been directly concerned with accretion, the principle of that case is equally applicable because accretion is an attribute of title and "the determination of the attributes of an underlying federal title, quite as much as the determination of the boundaries of the land reserved or acquired under such a title, 'involves the ascertainment of the essential basis of a right asserted under federal law.' "[356]

The rule in the *Washington* case was upheld several years later by the Supreme Court in *Hughes v. Washington*.[357] The issue involved whether the plaintiff, successor in title to an original federal grantee, was entitled to the gradual and imperceptible accretions added to her land both before and after the admission of Washington to the Union. The State trial court, relying upon the *Borax* and *Washington* decisions, held that federal law applied and confirmed title to the accreted lands in the plaintiff. The State supreme court, however, reversed, declaring that state rather than federal law governed in this instance. Since under the law of Washington the boundary was fixed as of the date of statehood, the court held that all accretions since that time belonged to the state rather than the littoral owner.

The case was then brought before the United States Supreme Court. The issue before the Court was whether or not a state could alter the ambulatory boundary between its tideland and uplands patented by the federal government prior to statehood by declaring that boundary to be permanently fixed at the line of ordinary high tide on

355. 294 F.2d 830 (9th Cir. 1961), *cert. denied*, 369 U.S. 817 (1962).
356. *Id.* at 832.
357. 389 U.S. 290 (1967).

the date of admission to statehood, thereby depriving the uplands owner of natural accretions occurring since that date. The Supreme Court held that this question was controlled by federal law, not state law, and therefore, that the littoral owner was entitled to the accretions. The Court relied on the *Borax* case to reach its decision: "While the issue appears never to have been squarely presented to this Court before, we think the path to decision is indicated by our holding in *Borax, Ltd. v. Los Angeles.* . . . No subsequent case in this Court has cast doubt on the principle announced in *Borax*."[358] The Court reached its decision in spite of the fact that the *Borax* case did not deal with accretions. The Court nevertheless declared:

> While this is true, the case did involve the question as to what rights were conveyed by the federal grant and decided that the extent of ownership under the federal grant is governed by federal law. This is as true whether doubt as to any boundary is based on a broad question as to the general definition of the shoreline or on a particularized problem relating to the ownership of accretion.[359]

The right asserted by Mrs. Hughes, whose predecessor in title had acquired the upland before statehood, was a right asserted under federal law. Under federal law accretion belonged to the upland owner. The main policy behind the federal common law was to protect the riparian owner's access to the water.[360] Therefore, the accretion to Mrs. Hughes' property belonged to her, and not to the state. In a concurring opinion, Justice Stewart recognized Washington's fixed boundary rule as a change in the state's water law. He argued that Mrs. Hughes' right to accretion should be based on the principle that the application of state law was a taking of property without compensation.[361]

Thus, both the *Washington* and the *Hughes* cases have recognized the ambulatory boundary as a part of federal law and have held that this principle will prevail over a contrary state rule. The exact scope of these decisions, however, is not entirely clear. While *Hughes* involved a federal patent made prior to statehood, both *Washington* and *Borax* involved patents made after statehood. It is therefore likely that federal law will govern wherever a federal patent is involved. This would virtually destroy the efficacy of any state law that attempted to establish a fixed boundary as far as those states carved out of the

358. *Id.* at 291-92.
359. *Id.* at 292.
360. *Id.* at 293.
361. *Id.* at 294-98.

federal domain are concerned,[362] including well over half of the coastline of the United States.

Washington and *Hughes* have changed the law of the State of Washington since that State had necessarily to abandon its fixed boundary position.[363] Louisiana may also have to reconsider its legal position in the light of the *Hughes* decision. Louisiana maintains that the owner of property abutting the Gulf of Mexico has no right to accretion formed by the sea.[364] Both Washington[365] and Florida[366] have considered the reasoning of *Hughes*—that the riparian owner must have access to the water—to decide cases involving accretion.[367]

The extent to which the title to accretion is a federal question was decided in *Hughes* only with respect to a grant made prior to statehood.[368] However, the court's language in *Hughes*[369] would indicate that whenever title has been derived from the federal government, federal law applies.

A very recent decision by the Supreme Court, *Bonelli Cattle Co. v. Arizona*[370] takes the position that when states are successors in title to the federal government they are subject to federal common law with respect to boundaries of land abutting on all navigable waters. *Bonelli* involved a dispute between the upland owner and the State of Arizona, as owner of the bed of the Colorado River, over title to land exposed

362. Note, *Florida's Sovereignty Submerged Lands: What Are They, Who Owns Them and Where is the Boundary?*, 1 FLA. ST. L. REV. 596, 630 (1973).

363. *E.g.*, Harris v. Hylebos Indus., Inc., 81 Wash. 2d 770, 505 P.2d 457 (1973); Vavrek v. Parks, 6 Wash. App. 684, 495 P.2d 1051 (1972); Wilson v. Howard, 5 Wash. App. 169, 486 P.2d 1172 (1971). Washington, however, does not recognize loss of title by erosion of land abutting lakes, bays or waters treated as lakes or bays if the land was conveyed by federal grant prior to statehood. This rule relies on the theory that the state may dispose of its land beneath navigable waters if it desires.

364. *See* Ker & Co. v. Conden, 223 U.S. 268 (1911); State v. Bayou Johnson Oyster Co., 130 La. 604, 58 So. 405 (1912); Zeller v. Southern Yacht Club, 34 La. Ann. 837 (1882); Note, *Alluvion, Islands, and Sand Bars*, 47 TUL. L. REV. 367, 374 (1973). Cautious petroleum companies are reported to be obtaining leases from both the state and the riparian owners. *Id.* at 374 n.42.

365. Hudson House, Inc. v. Rozman, 82 Wash. 2d 178, 509 P.2d 992 (1973). The court found necessary the equitable apportionment of a large, unusually-shaped accretion to avoid cutting off access to the water for an upland owner.

366. Board of Trustees of Internal Improvement Trust Fund v. Medeira Beach Nominee, Inc., 272 So. 2d 209 (Fla. Dist. Ct. App. 1973); Florida Nat'l Properties, Inc. v. Trustees of Internal Improvement Trust Fund, Case No. 74-5-G (Fla. Cir. Ct. Highlands County, May 3, 1974).

367. *See also* United States v. 1,629.6 Acres of Land, 335 F. Supp. 255, 269 (D. Del. 1971) (*Hughes* cited as favoring protection of access to water by riparian owner).

368. 389 U.S. at 291.

369. The location of the boundary was too great a national concern to be subject to state law. *Id.* at 293.

370. 414 U.S. 313 (1973).

by rechanneling the river. The Arizona Supreme Court considered the exposed land to be the result of avulsion since a sudden change in the character of the land was involved, and held that title to the exposed land remained in the State.[371] The Supreme Court of the United States reversed. Although urged to apply the *Hughes* analysis—that a federal question was involved because the upland owner traced his title through a federal grant—the Court rejected this argument[372] in favor of a broader rationale. A federal question was involved, the Court reasoned, because the State acquired its title to the river bed under the equal-footing doctrine.[373] Further, the State's title was a limited one in that it held the beds of navigable waters for the purpose of public navigation or "related public interests."[374] In cases in which the channeling project enhanced the State's interest in the navigability of the river, the Court decided that as a matter of public policy the State should not be permitted to acquire the exposed land in what would amount to "a windfall, since unnecessary to the State's purpose in holding title to the beds of the navigable streams within its borders."[375] To avoid this windfall, which would have resulted from classifying the drying up of the bottomlands as avulsion, the Court in effect redefined avulsion and accretion, no longer emphasizing the speed with which the change was brought about, but rather finding accretion because of the lack of "navigational or related public interests."[376] Lack of such interests, said the Court, calls for application of the "accretion theory,"[377] which gave the land to Bonelli, the

371. Arizona v. Bonelli Cattle Co., 107 Ariz. 465, 489 P.2d 699 (1971).

372. 414 U.S. at 321 n.11.

373. The states which entered the Union after its formation were admitted with the same rights as the original states within their respective borders. Mumford v. Wardwell, 73 U.S. (6 Wall.) 423 (1867). Title to lands under navigable waters passed to the new states under the equal footing doctrine. Pollard's Lessee v. Hagan, 44 U.S. (3 How.) 212 (1845).

374. 414 U.S. at 323.

375. *Id.* at 328.

376. *Id.* at 329.

377. The policies behind the doctrine of accretion are, however, fully applicable. Accretion theory guarantees the riparian character of land by automatically granting to a riparian owner title to lands which form between his holdings and the river and thus threaten to destroy that valuable feature of his property. The riparian owner is at the mercy, not only of the natural forces which create such intervening lands, but also, because of the navigational servitude, of governmental forces which may similarly affect the riparian quality of his estate. Accordingly, where land cast up in the Federal Government's exercise of the servitude is not related to furthering the navigational or related public interests, the accretion doctrine should provide a disposition of the land as between the riparian owner and the state.

Id. at 327.

adjoining landowner.[378] Since the tidelands were among the lands granted to those states that joined on an equal footing, along with land underlying navigable rivers, the principle of *Bonelli* should be equally applicable to the tidelands.[379]

The mean high water line is the federal standard for littoral boundaries,[380] and the federal common law recognizes the ambulatory boundary.[381] This does not solve, however, all the problems remaining to be faced by the state courts. Two similar cases, one in Florida and one in California, illustrate one of these problems and how at least two courts are approaching it.

(c) *State approaches to ambulatory shorelines*

In *People v. William Kent Estate Co.*,[382] a California appeals court decided a suit to quiet title brought by the lessee of a sandspit. The sandspit was bounded on one side by the Pacific Ocean, the tideland being owned by the State. The court found that the United States Coast and Geodetic Survey could establish the mean high tide line. The real problem was that the beach itself shifted perhaps as much as eighty feet between the summer and winter seasons.[383]

Kent commented authoritatively on the determination and meaning of the mean high water line, but did not solve the problem. The seasonal fluctuation could hardly be "gradual and imperceptible" so as to classify the change in the beach shoreline as accretion or reliction, declared the court.[384] Therefore the issue was retried in an attempt to establish a more definite or certain boundary. Since the proceeding was eventually dismissed on appeal as moot, the attempt was unsuccessful.[385]

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378. *Bonelli* solved one problem raised by *Hughes*. There are no longer two classes of upland owner, those deriving title from federal government and those deriving title from other sources. However, *Bonelli* also sharply focuses another inconsistency. Those states which were admitted to the Union on an "equal footing" with the original thirteen states are under federal common law as to water property boundaries. The thirteen original states and Texas may presumably apply state law. *Id.* at 336 (Stewart, J., dissenting).

379. The Court relied on the decisions in Shively v. Bowlby, 152 U.S. 1 (1894); Weber v. Board of Harbor Comm'rs, 85 U.S. (18 Wall.) 57 (1873); Pollard's Lessee v. Hagan, 44 U.S. (3 How.) 212 (1845), all involving tidelands. 414 U.S. at 318.

380. *See* Part III B(2)(a)(iii) *supra*.

381. *See* text accompanying notes 352-54 *supra*.

382. 242 Cal. App. 2d 156, 51 Cal. Rptr. 215 (1st Dist. Ct. App. 1966).

383. *Id.* The actual amount of movement of the land was in dispute.

384. *Id.* at —, 51 Cal. Rptr. at 218-19. On October 10, 1973, the court of appeal, in an unpublished opinion, dismissed the state's appeal as moot after defendant removed the fence. 1 Civil No. 31405 (1st Dist. Ct. App., Oct. 10, 1973).

385. Petition for rehearing was denied on November 9, 1973. Petitions for hearing

A similar Florida case, *Trustees of Internal Improvement Fund v. Ocean Hotels, Inc.*,[386] was an action to remove a seawall erected by the lessee hotel owner to prevent a part of its hotel from being undermined by the sea. This case also presented the problem of determining a boundary on a beach "which, through the natural processes of erosion and accretion, undergoes a predictable, seasonal loss and replenishment of approximately 90 feet of beach sand."[387] The trial court approached the problem directly. It summarily dismissed the fluctuating boundary concept as being unacceptable as a property law standard.[388] The possible solutions, as the court saw them, were to accept either the seaward mean high water line (summer line), the landward mean high water line (winter line), or the mean of the two. The mean of the summer and winter line was rejected as too costly to determine and an invasion of the public trust concept for at least part of the year. The summer line would likewise be violative of the public trust.[389] Consequently, the trial court accepted the winter line as the boundary. This solution was found to satisfy the State's interest in allowing the public the use of the beach.[390] *Ocean Hotels* is currently on appeal.[391]

In spite of the *Kent* and *Ocean Hotels* decisions, the use of a fluctuating boundary in such fact situations seems justified. The mean high water line *is* ascertainable. There is usually no great difficulty in determining the location of the line with respect to the shore at any given time. In light of the *Hughes* and *Bonelli* decisions, the ambulatory shoreline is a more acceptable property boundary than the winter line used by the *Ocean Hotels* court. *Hughes* relied on the supremacy of federal law over state law when a federal question is involved. The "winter line" approach is not a part of the federal common law; moreover, federal law clearly rejects such an argument as that of the trial court in *Ocean Hotels*, that water boundaries must be fixed to be certain. Further, the "winter line" clearly deprives the upland owner of title to the summer beach which he would hold under common law accretion principles. This may be an unconstitutional taking of property without compensation, as Justice Stewart argued in *Hughes*. His

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in the California Supreme Court were filed by the state and numerous amici curiae. There petitions were denied on December 19, 1973.

386. 40 Fla. Supp. 26 (Palm Beach County Ct. 1974).

387. *Id.* at 27.

388. *Id.* at 32.

389. *Id.* at 32-33.

390. *Id.* at 33.

391. *Appeal docketed*, No. 74-255, Fla. 4th Dist. Ct. App., Feb. 27, 1974.

"taking" argument was specifically recognized by the majority in *Bonelli* as defeating the state's claim to the disputed land.[392] Thus the "winter line" may be unconstitutional on the ground that federal law is supreme when a federal question is involved or on the ground that the use of that line is a taking of property without compensation.

There are other legal means available to protect public rights to beaches without doing violence to the ambulatory boundary concept. Even where title has been confirmed in the upland owner, the public may have acquired a prescriptive easement in the dry sand area[393] or a right to use the dry sand area by "custom."[394] Construction on the disputed area can be limited by set-back requirements established under the police power.[395] These requirements are much more likely to be upheld, as are other zoning laws, as not being a taking[396] than the fixed winter line approach of the trial court in *Ocean Hotels.*

An additional judicial tool for protecting the rights of the public in the area of seasonal ambulation between summer and winter mean high water lines is suggested by the recent holding of *Wilbour v. Gallagher.*[397] That case held that the owner of lands periodically covered by navigable waters of a fresh water lake may not interfere with public navigational rights by artificially filling such lands or erecting permanent structures thereon during a period of low water. In *Wilbour* the waters of Lake Chelan were periodically raised and lowered artificially in connection with power production. Defendants, whose lands were partially submerged annually for three months, filled the submerged parts of their property so that it could be used throughout the year. The Washington Supreme Court, holding that their fills constituted an obstruction to navigation, ordered them abated.[398] The

392. 414 U.S. at 331.

393. *See* City of Daytona Beach v. Tona-Rama, Inc., 294 So. 2d 73 (Fla. 1974). *See also* Comment, *Easements: Judicial and Legislative Protection of the Public's Right to Florida's Beaches,* 25 U. FLA. L. REV. 586 (1973).

394. *See* Hay v. Bruno, 344 F. Supp. 286 (D. Ore. 1972).

395. *See, e.g.,* FLA. STAT. §§ 161.052-.053 (1972).

396. *See* D. HAGMAN, URBAN PLANNING §§ 116-19 (1971); Van Alstyne, *Taking or Damaging by Police Power: The Search for Inverse Condemnation Criteria,* 44 S. CAL. L. REV. 1, 13-48 (1971). *But see In re* Opinion of Justices to House of Representatives, ___ Mass. ___, 313 N.E.2d 561 (1974).

397. 77 Wash. 2d 306, 462 P.2d 232 (1969).

398. In its decision, the court took the position that the same test is applicable to artificially raised and lowered navigable waters as is followed in cases involving naturally fluctuating water levels. It went on to state:

> [W]here the level of a navigable body of water fluctuates due to natural causes so that a riparian owner's property is submerged part of the year, the public has the right to use all the waters of the navigable lake or stream whether it be at the high water line, the low water line, or in between. . . . When the

rationale of the case seems equally applicable to lands periodically covered by the seasonal ambulation of tidally affected waters.

In addition to the possible state recognition and enforcement of a navigational easement of the *Wilbour* type, recent federal cases indicate a strong possibility of federal recognition of a similar federal easement. In *United States v. Sunset Cove, Inc.*,[399] the Federal District Court for the District of Oregon seemingly extended the jurisdiction of the Corps of Engineers to include dry sand areas within the limits of migration of a meandering navigable coastal river. By analogy this principle can arguably be extended to the ambulation of a sand beach between its summer and winter limits, thus giving the Corps authority to require permits under the Rivers and Harbors Act.[400] Federal regulatory power has been also extended under the Federal Water Pollution Control Act[401] in *United States v. Holland*,[402] which involved a dredge and fill operation on land "periodically inundated [by the tides but] above the mean high water line . . . ."[403] The land held to be under federal jurisdiction was mangrove wetland, but the federal pollution control authority could well be extended to the beaches as far as the waves wash to restrain construction or development on an ambulatory shoreline.

Another problem is artificial accretion. As a general proposition, the law with respect to accretion or reliction applies whether they result from natural or artificial causes.[404] This is not to say, however, that an artificial accretion caused by the littoral owner will be vested in him.[405] But, if the artificial accretion is not caused by him, in general

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land is submerged, the owner has only a qualified fee subject to the right of the public to use the water over the lands consistent with navigational rights, primary and corollary. . . .

. . . .

Thus, in the situation of a naturally varying water level, the respective rights of the public and of the owners of the periodically submerged lands are dependent upon the level of the water. As the level rises, the rights of the public to use the water increase since the area of water increases; correspondingly, the rights of the landowners decrease since they cannot use their property in such a manner as to interfere with the expanded public rights.

Id. at 314, 462 P.2d at 238.

399. 5 E.R.C. 1023 (D. Ore. 1973). This case is currently on appeal to the Ninth Circuit Court of Appeals.

400. 33 U.S.C. § 403 (1970).

401. *Id.* §§ 1251-1376 (Supp. II, 1972).

402. 373 F. Supp. 665 (M.D. Fla. 1974).

403. *Id.* at 675.

404. 56 AM. JUR. *Waters* § 486 (1947).

405. *E.g.*, McDowell v. Trustees of Internal Improvement Fund, 90 So. 2d 715 (Fla. 1956); Davis v. Morgan, 288 N.C. 78, 44 S.E.2d 593 (1947).

it will be awarded to him.[406]

Suppose, however, the accretion results from a legislatively authorized beach nourishment project. Arguably such projects may be legally justified under the police and general welfare powers to protect endangered lands.[407] Does this fact provide a valid legal basis for fixing the boundary on the landward side of the accreted land? Under such legislation in Florida,[408] once an erosion control line is established in connection with a beach nourishment project, title to all lands seaward of the line vests in the State. The common law of accretion no longer applies, although the person who owned to the mean high water mark before the line was established retains his riparian right of access,[409] and, if the agency responsible for maintaining the restored beach allows it to recede to the landward side of the erosion control line, the common law of erosion takes effect as to such land.[410] The line can be established only where severe beach erosion has occurred. The constitutionality of the legislation with respect to the title to the accreted land has been questioned,[411] but no square holding on the issue has yet been forthcoming in Florida. However, a Massachusetts beach nourishment project, which included no provision for access by riparian farmers over the accreted land was held not to vest title in the state despite the public benefit that resulted.[412] Perhaps an argument in favor of the Florida-type legislation can be constructed from the language of Justice Marshall in the *Bonelli* case concerning protection of "navigational or related public interests,"[413] which, the Court continued, "should not be narrowly construed because it is denominated

406. *See* Michaelson v. Silver Beach Improvement Ass'n, 342 Mass. 251, 173 N.E.2d 273 (1961).

407. *Cf.* Colberg, Inc. v. State *ex rel.* Dep't of Pub. Works, 67 Cal. 2d 408, 432 P.2d 3, 62 Cal. Rptr. 401 (1967); Candlestick Properties, Inc. v. San Francisco Bay Conservation & Dev. Comm'n, 11 Cal. App. 3d 557, 89 Cal. Rptr. 897 (1st Dist. Ct. App. 1970); Morris County Land Improvement Co. v. Parsippany-Troy Hills Township, 40 N.J. 539, 193 A.2d 232 (1963).

408. FLA. STAT. §§ 161.011-.211, 161.25-.45 (1972).

409. *Id.* § 161.201.

410. *Id.* §§ 161.211(2)-(3).

411. Trustees of Internal Improvement Trust Fund v. Medeira Beach Nominee, Inc., 36 Fla. Supp. 26 (Cir. Ct. Pinellas County 1971), *aff'd*, 272 So. 2d 209 (Fla. Dist. Ct. App. 1973). *See also* F. MALONEY, S. PLAGER & F. BALDWIN, *supra* note 7, § 126.7, raising similar doubts but suggesting that if the legislation preserves the riparian right of access of the upland owner, this might tip the balance in favor of the legislation. The Florida statute contains such a provision. FLA. STAT. § 161.201 (1972).

412. Michaelson v. Silver Beach Improvement Ass'n, 342 Mass. 251, 173 N.E.2d 273 (1961).

413. 414 U.S. at 329.

a navigational purpose."[414] Arguably one such public purpose could be the prevention of beach erosion and the restoration of public beaches on land formerly beneath navigable waters.[415] A more clearly acceptable approach to the beach erosion problem, however, might be to allow the law of accretion to apply and the littoral owner to gain title to the accreted beach lands, but legislatively to impose a public easement of access on the accreted lands along with imposing building restrictions on such land to guarantee that easement on the publicly financed additions.

In summary, the federal common law of water boundaries is rapidly supplanting state water boundary law governing much of the nation's coastline. This federal common law uses the ambulatory boundary, and the line of this ambulatory boundary is the mean high water line. A change at this time would raise serious constitutional questions because it arguably constitutes a deprivation of the landowner's accreted property without just compensation.[416] For these reasons the proposed model legislation retains the common law of the states regarding the legal effects of accretion, reliction, erosion and avulsion.[417] This common law, at least in those states subject to the federal common law, will necessarily include the ambulatory coastal boundary concept.

C. *Federal-State Conflicts in the Marginal Sea*

Although this article is primarily concerned with property rights along the shoreline, a brief examination of jurisdictional and property rights in the sea bed itself is appropriate. The discussion, however, will not deal with the international aspects of exploitation of sea bed resources, but will concentrate on the current dispute between the states and the federal government over the extent of their respective interests in offshore areas.

International law recognizes three categories of navigable waters: (1) the high seas, which are outside the jurisdiction of any particular nation;[418] (2) the marginal or territorial sea, which is a band of water

414. *Id.* at 323 n.15.

415. *But see* Board of Trustees of Internal Improvement Trust Fund v. Medeira Beach Nominee, Inc., 272 So. 2d 209 (Fla. Dist. Ct. App. 1973).

416. This argument is spelled out in Trustees of Internal Improvement Trust Fund v. Medeira Beach Nominee, Inc., 36 Fla. Supp. 26, 34-35 (Cir. Ct. Pinellas County 1971), *aff'd*, 272 So. 2d 209 (Fla. Dist. Ct. App. 1973).

417. Model Act § 4(2).

418. Gross, *The Maritime Boundaries of the States*, 64 MICH. L. REV. 639 (1966).

along the coast over which the nation exercises exclusive jurisdiction[419] except for a right of innocent passage afforded foreign vessels;[420] and (3) inland waters, which are located between the marginal sea and mean low water line.[421] In the United States, inland waters are generally state owned, but both federal and state governments have an interest in the marginal sea.

Prior to World War II the United States Supreme Court had uniformly upheld state ownership of tidelands,[422] and it was generally believed that the same rule applied to the submerged lands of the marginal sea.[423] In the 1930's however, the federal government began to assert a claim to submerged lands seaward of the mean low water line,[424] and the dispute was finally resolved in a series of Supreme Court cases known as the *Tidelands Decisions.*[425] In the first of these cases, *United States v. California,*[426] the Court held that California was not the owner of the marginal sea along its coast and that the federal government rather than the states had paramount rights[427] and powers over such waters. Moreover, according to the Court, this power included full dominion over the resources under the seabed, including

419. 1 A. SHALOWITZ, *supra* note 5, at 239.

420. For a discussion of the problems of national control over territorial waters and the right of innocent passage see M. MCDOUGAL & W. BURKE, THE PUBLIC ORDER OF THE OCEANS 196-282 (1962). *See also* The Corfu Channel Case, [1949] I.C.J. 8; C. FENWICK, INTERNATIONAL LAW 468-69 (4th ed. 1965).

421. *See generally* 1 A. SHALOWITZ, *supra* note 5, at 31-65; Gross, *supra* note 418, at 646-69.

422. *E.g.,* Borax Consol. Ltd. v. City of Los Angeles, 296 U.S. 10, 15 (1935); Appleby v. City of New York, 271 U.S. 364, 381 (1926); Port of Seattle v. Oregon & W.R.R., 255 U.S. 56, 63 (1921); Louisiana v. Mississippi, 202 U.S. 1, 8 (1906); Hardin v. Shedd, 190 U.S. 508, 519 (1903); Shively v. Bowlby, 152 U.S. 1, 14-18 (1894); Knight v. United States Lands Ass'n, 142 U.S. 161, 183 (1891); McCready v. Virginia, 94 U.S. 391, 394 (1876); Weber v. Board of Harbor Comm'rs, 85 U.S. (18 Wall.) 57, 66 (1873); Pollard's Lessee v. Hagan, 44 U.S. (3 How.) 212, 229 (1845); Martin v. Lessee of Waddell, 41 U.S. (16 Pet.) 366, 410 (1842).

423. Hanna, *The Submerged Lands Cases,* 3 BAYLOR L. REV. 201, 209 (1951); Metcalfe, *The Tidelands Controversy: A Study in Development of a Political-Legal Problem,* 4 SYRACUSE L. REV. 39, 41 (1952).

424. S.J. Res. 208, 75th Cong., 1st Sess. (1937); E. BARTLEY, THE TIDELANDS OIL CONTROVERSY, 95-158 (1953); Metcalfe, *supra* note 423, at 40-59; Note, 29 U. CINN. L. REV. 510, 511-12 (1960); *see* Comment, *Conflicting State and Federal Claims of Title in Submerged Lands of the Continental Shelf,* 56 YALE L.J. 356 (1947).

425. United States v. Texas, 339 U.S. 707 (1950); United States v. Louisiana, 339 U.S. 699 (1950); United States v. California, 332 U.S. 19 (1947).

426. 332 U.S. 19 (1947). For an analysis of the *California* case see E. BARTLEY, *supra* note 424, at 59-78; 1 A. SHALOWITZ, *supra* note 5, at 3-10; Hanna, *The Submerged Land Cases,* 3 STAN. L. REV. 193, 196-209 (1951); Comment, *United States v. California: Paramount Rights of the Federal Government in Submerged Coastal Lands,* 26 TEXAS L. REV. 304 (1948).

427. *See* E. BARTLEY, *supra* note 424, at 247-73.

oil.[428] The Court reasoned that the constitutional responsibilities of the federal government over foreign affairs required that its paramount powers in the marginal sea be recognized.[429] The claims of Louisiana[430] and Texas[431] to adjacent submerged lands in the Gulf of Mexico were rejected for similar reasons.

As a result of pressure from the affected coastal states,[432] Congress in 1953 passed the Submerged Lands Act[433] that relinquished to certain states the federal government's interest in all submerged lands in the marginal sea within state boundaries.[434] Under the provisions of the statute, state boundaries were to be those existing at the time of admission into the union.[435] However, state boundaries approved by Congress prior to the Act were also confirmed. Moreover, any state was allowed to extend its seaward boundary to three miles.[436] The Outer Continental Shelf Lands Act[437] provided for the administration of submerged lands, seaward of state boundaries, that remained under the control of the federal government.[438]

The constitutionality of the Submerged Lands Act was upheld in 1954,[439] but the Supreme Court did not interpret the legislation until it decided *United States v. Louisiana*[440] in 1960. In this case the federal government claimed all submerged lands in the Gulf of Mexico

428. 322 U.S. at 38-39.

429. Hanna, *supra* note 426, at 204. The Court suggested that jurisdiction over the marginal sea had been created solely as an aspect of federal sovereignty and reflected an assertion of national rather than local interests. Since this extension had taken place after the formation of the Union, the original states derived no rights in the marginal sea as an attribute of their sovereignty. 332 U.S. at 32-35. The equal footing doctrine required that subsequently admitted states relinquish any claims to the marginal sea based on their pre-admission boundaries. Gross, *supra* note 418, at 640-41.

430. United States v. Louisiana, 339 U.S. 699 (1950); E. BARTLEY, *supra* note 424, at 195-212.

431. United States v. Texas, 339 U.S. 707 (1950); Hanna, *supra* note 426, at 209-18.

432. Metcalfe, *supra* note 423, at 64-89.

433. 43 U.S.C. §§ 1301-15 (1970).

434. *See generally* 1 A. SHALOWITZ, *supra* note 5, at 115-80.

435. 43 U.S.C. § 1312 (1970).

436. *Id.*; Gross, *supra* note 418, at 644.

437. 43 U.S.C. §§ 1331-43 (1970); 1 A. SHALOWITZ, *supra* note 5, at 181-99; Christopher, *Outer Continental Shelf Lands Act: Key to a New Frontier*, 6 STAN. L. REV. 23 (1953).

438. The claims of federal government vis-à-vis other nations with respect to development of the resources of the outer continental shelf are outside the scope of this article. *See* 1 A. SHALOWITZ, *supra* note 5, at 371-77.

439. Alabama v. Texas, 347 U.S. 272 (1954). The Court stated that "[t]he power of Congress to dispose of any kind of property belonging to the United States 'is vested in Congress without limitation.'" *Id.*

440. 363 U.S. 1 (1960). *See* 1 A. SHALOWITZ, *supra* note 5, at 140-43.

more than three geographical miles[441] from the coast of the respective Gulf Coast states. The states claimed coastal boundaries of three marine leagues or more. The Court declared that a state's claim must be based on " 'its constitution or laws prior to or at the time such State became a member of the Union' "[442] and that such a claim must also be recognized by Congress in admitting the state to the Union. Thus the Court declined to rule that preadmission boundaries, by themselves, met the requirements of the Submerged Lands Act.[443] Accordingly, the Court held that the coastal boundaries of Louisiana, Alabama and Mississippi extended only three geographical miles beyond the mean low water line.[444] However, the Court did recognize the claims of Texas[445] and Florida[446] to coastal boundaries of three marine leagues in the Gulf of Mexico.

While the major coastal boundary questions have apparently been settled with respect to the Pacific and Gulf coastal states, the states along the Atlantic coast recently have laid claim to vast areas of the seabed on the basis of their colonial charters.[447] The coastal states have asserted that the three mile limit provisions of the Submerged Land Act were not applicable to them. As successors in title to England or its grantees, they have exercised dominion and control over the marginal sea along their coastlines since the colonial period and never surrendered this authority to the federal government. The federal

441. One English statute or land mile equals about 0.87 marine, nautical or geographical mile. The "three-mile limit" of international law refers to three marine miles, or approximately 3.45 land miles. 363 U.S. at 17 n.15. A marine league is equal to three geographical miles. 2 A. SHALOWITZ, *supra* note 5, at 580.

442. 363 U.S. at 29, *quoting* 43 U.S.C. § 1312 (1970).

443. Henri, *The Atlantic States' Claim to Offshore Oil Rights: United States v. Maine*, 2 ENVIRON. AFFAIRS 827, 831 (1972).

444. The act of admission with respect to Louisiana had described the boundaries of the state as "including all islands within three leagues of the coast." 2 Stat. 702 (1812). Similar clauses in their respective acts of admission described the boundaries of Alabama and Mississippi as "including all islands within six leagues of shore." 3 Stat. 490 (1819) (Alabama); 3 Stat. 348 (1817) (Mississippi). The states had argued that this language implied that all waters between such islands and the mainland were included within their coastal boundaries. The Court, however, held that the states were only entitled to a three-mile belt around the mainland and the islands. 363 U.S. at 66-83; Gross, *supra* note 418, at 644.

445. 363 U.S. at 36-65; 1 A. SHALOWITZ, *supra* note 5, at 136-40. The Court determined that the annexation resolution of 1845, 5 Stat. 797 (1845), had recognized a maritime boundary of three leagues for Texas. *See* Gross, *supra* note 418, at 642 n.21; Henri, *supra* note 443, at 836 n.29.

446. United States v. Florida, 363 U.S. 121 (1960). The Court found that upon Florida's readmission to the Union after the Civil War, 15 Stat. 73 (1868), Congress had approved a new state constitution which included a coastal boundary of three marine leagues.

447. *See generally* Henri, *supra* note 443; Flaherty, *supra* note 45.

government, on the other hand, has maintained that the 1947 *California* decision controls. At stake are oil and natural gas deposits estimated to be as large as those in the Gulf.[448] In 1969 the federal government invoked the original jurisdiction of the Supreme Court to resolve the dispute.[449] The case has not yet been decided although a special master, appointed by the Court, recommended in August 1974 that the claims of the states be disallowed.

The Submerged Lands Act provides that the three mile limit begins at the "coastline," defined as "the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters . . . ."[450] Accordingly, the proposals discussed subsequently in the article are relevant to federal-state coastal boundaries, as well as those of private landowners.[451]

IV. A Legislative Approach to Shoreline Boundaries

A. A Proposed Model Act

Two years ago, at the request of the Florida Department of Natural Resources, the authors commenced work on proposed legislation to authorize a permanent program of coastal mapping in that State.[452] With the assistance of personnel from NOAA and NOS,[453] a bill was produced, which was subsequently enacted into law as the "Florida Coastal Mapping Act of 1974."[454] From the very beginning,

448. One commentator estimates that the Atlantic seabed contains 5.5 billion barrels of oil, 37 trillion cubic feet of gas, and 1.1 billion barrels of natural gas liquids. Henri, *supra* note 443, at 828.

449. United States v. Maine, 395 U.S. 955 (1969).

450. 43 U.S.C. § 1301(c) (1970).

451. There are many complex problems associated with demarcation of coastal boundaries under the Submerged Lands Act as well as under international law, particularly in the case of bays, rivers and inlets. *See generally* United States v. California, 381 U.S. 139 (1965). Since these problems involve a federal question, they were not treated in the Model Act, which operates only at the state level. Shalowitz, *Boundary Problems Raised by the Submerged Lands Act*, 54 Colum. L. Rev. 1021 (1954).

452. The history of the present NOS-Florida coastal mapping program is discussed in text accompanying notes 584-85 *infra*.

453. The authors wish to express their appreciation to Hugh Dolan, Chairman, Board of Appeals, Department of Commerce; Commander Wesley Hull, Chief, Coastal Mapping Division, NOS; Cal Thurlow, Chief, Tides Division, NOS; Carl Johnson, General Counsel's Office, NOAA; Captain Jack Guth, Coastal Mapping Coordinator, Florida Department of Natural Resources; Colonel Jervey Kelly, Administrative Assistant, Florida Department of Natural Resources; and Fred Waldinger, Assistant to Coastal Mapping Coordinator, Florida Department of Natural Resources, for their comments and suggestions regarding the content of the Model Act.

454. Ch. 74-56, [1974] Fla. Laws 34.

however, it was felt that the proposed act might serve as a model for use in other coastal states.[455]

The proposed statute contains three major elements. First, it provides a precise definition of the "mean high water line" and declares it to be the boundary between privately-owned upland and state-owned sovereignty submerged lands in coastal areas. Secondly, it sets forth the required procedures for the determination of tidal datums including mean high water and regulates the methods by which surveyors can locate the mean high water line on the ground. Finally the proposed act authorizes the implementation of a continuing program of coastal boundary mapping.

The Act is to be administered by an existing state agency with jurisdiction in natural resources, coastal zone management or related areas.[456] The agency is authorized to coordinate the efforts of all public and private organizations engaged in tidal survey or coastal mapping activities.[457] It may also assist courts, legislative bodies and administrative agencies and provide them with information regarding tidal surveys or coastal boundary determinations.[458] Moreover, the agency is empowered to compile permanent records of tidal surveys and maps of the state's coastal areas,[459] to collect and preserve appropriate survey data from coastal areas,[460] and to act as a public repository for copies of coastal maps.[461]

In addition to these record keeping and research functions, the agency is vested with considerable regulatory authority under the provisions of the Model Act. The agency's regulatory powers will be discussed below.[462]

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455. The Model Act is unique. No comparable statute or administrative regulation was discovered although the laws of twenty-eight states were researched and the appropriate administrative agencies in all of these states were contacted for assistance. Moreover, the laws of eleven coastal European nations were checked without obtaining any significant help. This research is reproduced in F. Maloney & R. Ausness, The Proposed Florida Coastal Mapping Act and Its Relationship to Coastal Boundary Determination and Coastal Management in Florida 77-83 (1973) (unpublished report to Legislature of Florida on file with Florida Department of Natural Resources).

456. Model Act § 5(1). The Florida act is administered by the Department of Natural Resources. Ch. 74-56, § 5(1), [1974] Fla. Laws 36. Specific references to Florida or to the Department of Natural Resources have been omitted. All significant differences between the Florida statute and the Model Act will be mentioned or discussed in the footnotes.

457. Model Act § 5(2)(a).

458. *Id.* § 5(2)(c).

459. *Id.* § 5(2)(e).

460. *Id.* § 5(2)(g).

461. *Id.* § 5(2)(h).

462. *See* text accompanying notes 577-79 *infra*.

Finally, the Model Act contains thirty-one definitions,[463] either taken verbatim from NOS publications[464] or reviewed for technical accuracy by NOS personnel. Twenty-one of these definitions are employed in the statute itself,[465] while the remainder are included for possible use by the agency in its rules and regulations.[466]

B. Legislative Recognition of the Mean High Water Line

One of the primary objectives of the Model Act is to define public and private property boundaries as precisely as possible. Accordingly, section 4 declares the mean high water line to be the usual limit of private ownership in coastal areas. The proposed act defines "mean high water" as "the average height of the high water over a nineteen-year period; or for a shorter period of observations, the average height of the high waters after corrections are applied to eliminate known variations and to reduce the result to the equivalent of a mean nineteen-year value."[467] The "mean high water line" is "the intersection of the tidal plane of mean high water with the shore."[468]

The decision of the United States Supreme Court in *Borax Consolidated Ltd. v. City of Los Angeles*,[469] discussed earlier, provides the legal justification for the use of a "mean high water line" as a property line in the Model Act. While the older common-law standard is vague and uncertain, the mean high water line standard utilized in the Act has an accepted scientific meaning. In addition, since it is used by NOS, both governmental agencies and private property owners can make use of NOS survey data in locating their own boundaries.

States which recognize the low water mark as the boundary between upland and submerged land[470] may substitute for section 4 a pro-

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463. Model Act § 3.

464. These publications include H. MARMER, *supra* note 77; P. SCHUREMAN, *supra* note 76; 2 A. SHALOWITZ, *supra* note 5.

465. These include "agency," "apparent shoreline," "approved coastal zone map," "comparison of simultaneous observations," "control tide station," "datum," "datum plan," "foreshore," "geodetic bench mark," "local tidal datum," "mean high water," "mean high-water line," "mean low water," "mean low-water line," "mean range difference," "national map accuracy standards," "tidal bench mark," "tidal datum," "tide," "tide station," and "time difference."

466. These include "demarcation," "diurnal tides," "interpolated water elevation," "leveling," "mixed tide," "nineteen-year tidal cycle," "nonperiodic forces," "photogrammetry," "semidiurnal tides," and "tidal day."

467. Model Act § 3(15).

468. *Id.* § 3(16).

469. 296 U.S. 10 (1935).

470. *E.g.*, Delaware, Georgia, Maine, Massachusetts, New Hampshire, Pennsylvania and Virginia.

vision declaring the mean low water line to be the correct standard. Both "mean low water"[471] and "mean low water line"[472] are defined in the statute. Moreover, because of their significance in the demarcation of federal-state boundaries under the Submerged Lands Act,[473] mean low water datums are routinely determined by NOS and can, therefore, conveniently be represented on approved coastal zone maps.[474]

As previously discussed, even in high water jurisdictions, the mean high water line does not always constitute the boundary between public and private lands. These also include, for example, grants of submerged lands by the state as well as grants by foreign powers or the federal government prior to statehood. Accordingly, such exceptions to this general rule must be taken into account by any legislation which purports to establish coastal boundaries.

Therefore, language in section 4 recognizes that some states have made valid grants of submerged land to private landowners under various reclamation and improvement statutes.[475] The Model Act declares that no provision "shall be deemed to constitute a waiver of state ownership of sovereignty submerged lands, nor shall any provision of this act be deemed to impair the title to privately-owned submerged lands validly alienated by the state or its legal predecessors."[476] This language avoids any questions concerning the validity of land grants prior to statehood. Grants of submerged lands below the mean high water line by foreign powers[477] or the federal government[478] have been upheld by the United States Supreme Court and could not, therefore, be invalidated unilaterally by state legislation.

Another exception to the general rule may occur for tidal flats, inlets and bays. In some states all tidal waters are considered navi-

471. "Mean low water" is "the average height of the low waters over a nineteen-year period; or for shorter periods of observations, the average height of low waters after corrections are applied to eliminate known variations and to reduce the result to the equivalent of a mean nineteen-year value." Model Act § 3(17).

472. The "mean low water line" is defined as "the intersection of the tidal plane of mean low water with the shore." *Id.* § 3(18).

473. 43 U.S.C. §§ 1301-15 (1970).

474. Both the mean low water line and the mean high water line appear on maps produced in connection with the NOS-Florida coastal mapping program.

475. *E.g.*, FLA. STAT. § 253.121 (1967); *see* F. MALONEY, S. PLAGER & F. BALDWIN, *supra* note 7, §§ 120-28.

476. Model Act § 4(1).

477. Knight v. United States Land Ass'n, 142 U.S. 161 (1891); City of San Francisco v. LeRoy, 138 U.S. 656 (1891).

478. Shively v. Bowlby, 152 U.S. 1, 47-48 (1894). *See also* United States v. Alaska, 423 F.2d 764 (9th Cir. 1970) (fresh water lake).

gable, while other states treat tidal waters as navigable only if they are navigable in fact.[479] The qualifying phase "along the shores of land immediately bordering on navigable waters" is recommended for use in such states.[480]

Finally, the Model Act fully recognizes the ambulatory nature of coastal boundaries.[481] Section 4(2) states that nothing in the Act is intended to modify the common law with respect to the legal effects of accretion, reliction, erosion or avulsion. The mean high water line as mapped must of necessity represent the boundary at a given point in time. Where shoreline alteration occurs, although the elevation of mean high water remains constant and determinable by survey, the physical boundary will shift, and will no longer correspond to the line represented on the map. Thus, the Act does not attempt to "freeze" property lines as of the date of the map.

C. *Coastal Surveys*

In most jurisdictions the mean high water line is the recognized boundary between state-owned submerged lands and privately-owned upland property in coastal areas.[482] Until recently, however, determining the exact location of the mean high water line was not considered important by the public and was consequently neglected by the engineering and surveying professions.[483] In the absence of a scientifically accurate delineation, a number of methods were utilized to approximate the actual location of the mean high water line. While these procedures were perhaps adequate for some purposes, the results obtained were often arbitrary and inaccurate.[484] Recent demands, however, for coastal property have accentuated the need for more precise demarcation of coastal boundaries.[485] In addition, public recognition of the ecological value of the coastal zone and the need for the con-

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479. *See* Part III B(2)(b)(ii) *supra.*

480. Model Act § 4(1) would then read: "The mean-high water line *along the shores of land immediately bordering on navigable waters* is recognized and declared to be the boundary between the foreshore owned by the state in its sovereign capacity and upland subject to private ownership. . . ." (emphasis added).

481. *See* Part III B(3) *supra.*

482. 3 AMERICAN LAW OF PROPERTY § 12.27 (A.J. Casner ed. 1952); Comment, *Fluctuating Shorelines and Tidal Boundaries: An Unresolved Problem*, 6 SAN DIEGO L. REV. 447, 455 (1969).

483. Guth, *supra* note 6, at 33.

484. The use of geodetic levels in determining tidal elevations is an example.

485. Presentation of Rear Admiral Allen Powell, Director NOS, to Congressman Bob Sikes, May 3, 1974 [hereinafter cited as A. Powell].

servation of the nation's marine resources[486] has reinforced the need for a more reliable methodology for coastal surveys.[487] In response to this need, the Model Act requires the agency to "develop uniform specifications and regulations for tidal surveying and mapping in coastal areas of the state."[488]

(1) Determination of Tidal Datums

(a) *Local tidal datums*

A significant aspect of a tidal datum as a marine boundary is the accuracy and consistency of its recoverability.[489] A well-established tidal datum, when referenced to permanent monuments such as tidal bench marks, is readily available for the surveyor to use for demarcating the shoreline. Even when these marks are destroyed, it is possible to recover the same datum with remarkable accuracy from a short series of tidal observations.[490]

In the past, however, surveyors assumed that mean sea level was a uniform elevation along the entire coast line of the United States.[491] Therefore, once a vertical datum for the mean high tide was established by a control tide station, this value was taken inland and leveled[492] by conventional methods along a road or other suitable surface until the property in question was reached. Then the mean high water value would be located on the shore.[493]

A mean high tide level, however, is not actually a uniform level. Instead it is an undulating line that varies from point to point. As a result, the intersection of a mean high tide with the land connects points of differing elevation and forms a vertically undulating line. A mean high tide line must not, therefore, be regarded as a contour line.[494] It

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486. *See generally* D. HOOD, IMPINGEMENT OF MAN ON THE OCEANS (1971); W. MATTHEWS, F. SMITH & E. GOLDBERG, MAN'S IMPACT ON TERRESTRIAL AND OCEANIC ECOSYSTEMS (1971); B. KETCHUM, *supra* note 1.

487. Guth, *supra* note 6, at 33-34.

488. Model Act § 5(2)(f).

489. Recovery is the process of finding local tidal datums by reference to permanent tidal benchmarks. This process also insures that the datum can be verified. *See* H. MARMER, *supra* note 77, at 24-25.

490. A. Powell, *supra* note 485, at 4.

491. 2 A. SHALOWITZ, *supra* note 5, at 62-63 n.49.

492. For a description of leveling see H. RAPPLEYE, MANUAL OF GEODETIC LEVELING (U.S. Coast & Geodetic Survey Spec. Pub. No. 239, 1948).

493. *See* 2 A. SHALOWITZ, *supra* note 5, at 48-49, 62-63, 173-75.

494. Guth, *supra* note 6, at 35; Ordnance Survey, High and Low Water Marks as shown on Ordnance Survey Maps, Leaflet No. 5 (OS 705), ¶ 3, July 1970 (Great Britain). "Contour" is defined as "an imaginary line on the ground all points of which

follows that a method for accurately determining coastal boundaries must be based on local tidal datums. Moreover, because of the undulating nature of tidal elevations, the survey must proceed from the water side to the land instead of vice versa. Consequently, the land based method described above is not acceptable to NOS nor allowed under the Model Act.[495]

Because of the inadequacies of a mean high water line established by leveling methods, NOS has developed a more accurate procedure which utilizes local tidal datums.[496] First, a tidal benchmark is placed in the area where a long-term control tide is to be located. The tidal benchmark[497] is a fixed point to which the tidal datum from the station can be referred. Next, a nineteen-year tide station is set up in the vicinity of the tidal benchmark and tide levels are referenced to it for this period. A nineteen-year period of tidal observations is required to cover all of the tidal cycles.[498] The Model Act, however, would not require nineteen-year observations by private persons. This responsibility has been assumed by NOS. At the present time there are 130 control tide stations located along the entire American coastline.[499] These stations comprise the "National Tide Observation Network."[500] However, it has been estimated that an additional seventy stations are needed in order to obtain sufficient data for the accurate mapping of coastal boundaries.[501]

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are at the same elevation above a specified datum surface." 2 A. SHALOWITZ, *supra* note 5, at 556.

495. Section 15 of the Model Act states that geodetic bench marks shall not be used unless approved by the agency. Geodetic bench marks are based on a transcontinental leveling based on the Mean Sea Level Datum of 1929 (redesignated in 1973 as NGVD-National Geodetic Vertical Datum) and do not necessarily reflect the local mean high water elevation. Guth, *supra* note 6, at 35. Therefore, they may be used only when NOS or the agency supplies a correction factor so that they may be related to the local tidal datum.

496. A. Powell, *supra* note 485, at 3-4; NOS, Federal-State Mapping Series, Map No. TP-00143 (Fla.-NOAA Coastal Boundary Mapping Program 1973) [hereinafter cited as NOS Map].

497. Information on local tidal elevations is preserved by brass disks which may be sunk into concrete monuments. H. MARMER, *supra* note 77, at 24; *see* Model Act § 3(26).

498. For description of tide gauges used to record observations over a period of months see H. MARMER, *supra* note 77, at 26-28.

499. A. Powell, *supra* note 485, at 3.

500. *Id.* at 3.

501. *Id.* at 3-5. The information provided by these control tide stations enables NOS to calculate the following vertical datums: (1) mean high water; (2) mean low water; and(3) mean water level. From these vertical datums the following horizontal components can be located: (1) mean high water line; (2) mean low water line; and (3) mean water level line.

In areas, such as bays and estuaries, where topographic and hydrographic conditions affect the tidal pattern, additional tide stations must be established. Tidal observations must be taken at these stations for at least twelve months in order to average out seasonal variations and short-term meteorological effects.[502] The information obtained from these twelve-month tide stations is then compared with the nearest control tide station data and corrected to an appropriate nineteen-year value.[503] As a general rule, twelve-month stations are maintained by governmental agencies, such as NOS, rather than by private individuals.

The elevation of mean high water in areas between long-term tide stations may be obtained by installation and observation of tide gauges for thirty day periods at such locations. The data obtained from these stations must be referred back through the twelve-month tide stations to the control tide station data and corrected to the appropriate nineteen-year values. In addition, tidal datums obtained from all types of tide stations should be referenced to permanent monuments to assure accurate and consistent recovery by field surveyors.[504]

NOS and other governmental agencies utilize thirty-day tide stations as part of their coastal mapping activities; the Model Act would require private parties to employ these procedures also in order to determine local tidal elevations. This procedure is described and authorize in section 14 of the Act.[505] While this method may be somewhat expensive, it is generally the only way to establish the correct local tidal datum and thus insure an accurate determination of the coastal boundary.

In some cases, however, a cheaper and less time-consuming procedure can be utilized without breaching acceptable standards of accuracy. This approach, known as "interpolated water elevation" or IWE method, is also allowed with the consent of the agency.[506] An interpolated water elevation (IWE) point is a local mean high water elevation determined by interpolation from established datums at two adjacent tide stations.[507] IWE points can be established by transfer,

502. *Id.* at 4.

503. There are two methods utilized to correct tidal datum obtained from short-time observation to nineteen-year tidal datum: (1) comparison of simultaneous observations; (2) correction by tabular values. The first method is generally more satisfactory. Both methods are described in detail in H. MARMER, *supra* note 77, at 87-95.

504. Tidal bench marks provide the means for recovering datums determined from tidal observation. *Id.* at 24.

505. Model Act §§ 14(1)-(2).

506. *Id.* §§ 14(3)-(6).

507. *Id.* § 3(12).

provided that the shoreline characteristics between the adjacent tide stations are similar and uninterrupted. In addition, time and range differences must be within acceptable limits.[508]

(b) Mean high and mean higher high water datums

While the mean high water datum normally reflects an average of all daily high tides, problems may arise where certain tidal characteristics are encountered. There are three types of tide: daily, semidaily and mixed.[509] A tide is considered to be daily or diurnal when only one high and one low water occur within a single tidal day.[510] In a semidaily or semidiurnal tide, two complete tidal cycles take place so that there are two high and two low waters each tidal day.[511] There is little diurnal inequality, however, associated with a semidaily tide. Diurnal inequality refers to differences in height between corresponding morning and afternoon tides.[512] In a mixed tide, two high and two low waters occur within a single tidal day, but there is also significant diurnal inequality.[513] This inequality may arise with respect to the high waters, low waters, or both.[514]

Since "mean high water" is the average height of the high waters over a nineteen-year period, there is no difficulty in calculating the mean high water elevation when only one high water occurs during a particular day. However, when two high waters occur, as in the case of semidaily and mixed tides, a determination must be made whether

508. Until experience establishes better guidelines, the time difference between adjacent tide datums should not exceed ten minutes, and the range difference between adjacent tide datums should not exceed ten percent. *See* Guth, *supra* note 6, at 5.

509. *See* Part III A *supra.*

510. The Model Act § 3(9) defines "diurnal tides" as "tides having a period or cycle of approximately one tidal day." A "tidal day" is "the time of the rotation of the earth with respect to the moon, or the interval between two successive upper transits of the moon over the meridian of a place." *Id.* § 3(28). The usual tidal day is 24 hours and 50 minutes. *See* H. MARMER, *supra* note 77, at 9.

511. "Semidiurnal tides" are defined in the Model Act as "tides having a period of approximately one-half of a tidal day." Model Act § 3(25).

512. *See* H. MARMER, *supra* note 77, at 10.

513. The term "mixed tide" is defined as "the type of tide in which the presence of a wave is conspicuous by a large inequality in either high or low water heights with two high waters and two low waters usually occurring each tidal day. The name is usually applied to the tides intermediate to those predominantly diurnal and those predominantly semidiurnal." Model Act § 3(20). Strictly speaking, all tides contain both daily and semidaily constituents. In the semidaily type, however, the daily element is insignificant, while in the daily type, the semidaily influence is minimal. Where the two constituents are nearly equal, a mixed tide results. H. MARMER, *supra* note 77, at 17. NOS has devised mathematical formulas to determine whether a particular tidal pattern should be classified as daily, semidaily or mixed. *Id.* at 21-22.

514. H. MARMER, *supra* note 77, at 17.

to include both of the high water levels in the calculation of mean high water. If only the higher of the two highs is used, the resulting tidal datum is "mean higher high." Since this tidal elevation is higher than one that would include the lower highs as well, its use in coastal boundary determinations would result in a loss to the upland owner and a gain to the owner of the submerged bed, usually the state.[515]

Normally it would seem that both high waters should be considered in determining the mean high water elevation.[516] An exception to this principle of using both high waters may be warranted in areas where one daily tide is predominant, but where mixed tides occur at certain periods each month. These secondary tides, because of their small range, are often difficult to measure. Therefore, it has been suggested that these occasional secondary high waters be ignored when mean high water is determined.[517]

In some areas where mixed tides occur, predominant diurnal or semidiurnal tide may not be obvious. The selection of a specific datum plane in such mixed tide areas may have to be deferred until adequate tide data is collected and analyzed. Until such data is established, the mean higher high water can provide a reliable datum for engineering and surveying purposes. Although this mean higher high water datum may not be the boundary between state and private ownership, its use will protect public lands and prevent possible irreparable encroachment by private development. For this reason the Florida Coastal Mapping Coordinator has tentatively decided to map the mean higher high water line in such areas pending development of sufficient data so that when appropriate, both high waters can be utilized for purposes of calculating mean high water.[518]

(2) Demarcation of the Shoreline

Once the proper tidal elevation is determined, the surveyor must then ascertain the horizontal component. Section 15 states that "the location of the mean high water line or the mean low water line shall be determined by methods which are approved by the agency for the

515. The Texas courts have used the mean higher high water line to delimit the boundaries of Spanish and Mexican land grants made prior to 1836. Luttes v. Texas, 159 Tex. 500, 324 S.W.2d 167 (1958). *See also* Roberts, *supra* note 79.

516. H. MARMER, *supra* note 77, at 86.

517. *Id.* at 86-87.

518. Telephone conversation between Jack Guth, Coastal Mapping Coordinator, State of Florida, and F. Maloney, Sept. 6, 1974.

area concerned."[519] The agency, therefore, must issue detailed regulations to describe acceptable procedures. These will depend on the degree of accuracy required and the shoreline conditions involved.

(*a*) *Survey methodology*

There are several methods which can be used to determine coastal boundaries once the proper tidal datums have been established. For large-scale coastal mapping infra-red photography is the most appropriate method.[520] This approach will be used by NOS to prepare the approved coastal zone maps authorized by the Model Act. After tidal datums are established, an airplane is flown over the area to be mapped at precisely the time when the water is at the level corresponding to the desired tidal datum. This is accomplished through radio communication between the aircraft crew and ground personnel at the appropriate tide station.[521]

Coastal boundary maps can be produced from these photographs. The accuracy of these maps depends on both the map scale and the photographic scale. Where greater accuracy is required, a field survey on the ground will be required. Where this method is used, local tidal datums must be determined, as always, by tidal observations from a thirty-day tide station or by means of the IWE procedure. After adequate tide datums are established for the specific area, the horizontal location of mean high water at specific points on the shore may be accomplished by leveling from the tide stations to points of land in the immediate area, or preferably by observing the intersection of the water with the land at mean high tide at these points.[522] If the shore is gently sloping or the bottom uneven, it is particularly important that the observation of the intersection of the water with the shore be as close as possible to the tide stations. Once a sufficient number of these points are located, they may be joined by appropriate techniques, in-

519. Model Act § 15.

520. Aerial photographic coverage of a mapped area includes both black and white infrared film exposure and natural color film exposure. The infrared film captures the land/water interface. W. HULL, *supra* note 4, at 4.

521. For a detailed description of the actual process of insuring the accuracy of the aerial photography see *id.* at 4-6.

522. "At that precise time [mean high tide] when the high water reaches that exact mark on the staffs on either side you mark the line where the water is—actually where the water is. So the water does the survey, nothing else." Testimony of J. Guth, *In re* Committee Meeting Estero Bay Land Transactions, Committee on Natural Resources, at 238 (Lee County, Fla., Nov. 15, 1973).

cluding, in suitable cases, aerial photography[523] or the use of botanical data,[524] or a combination of both. Leveling over extensive distances is not an appropriate method of joining such points.[525]

(b) Surveys in vegetated areas

Since the National Ocean Survey is primarily concerned with navigational charts, it maps only the apparent shoreline[526] in areas where the mean high water line is obscured by vegetation. The apparent shoreline is defined as the intersection of the mean high water datum with the outer limits of vegetation that present to the navigator the appearance of the shoreline.[527] Since the mean high water line may actually be considerably landward of the apparent shoreline[528] in most areas, the apparent shoreline cannot be used as a property boundary line.

Recommended NOS survey procedure[529] for establishing the *actual* mean high water line in vegetated areas is, when possible, to physically trace a line on the ground, even though this may involve wading and staking.[530] The density and resistance of marsh and mangrove stands to penetration limits the use of line of sight surveying and also adds to the difficulty of accurately establishing the mean high water line in heavily vegetated areas.

These difficulties have led to the use of other approaches to establishing boundary lines in such areas. The least satisfactory has been the substitution of a fixed line, the meander line, for the actual boundary. The second approach, proposed by some biological scientists, is to use the vegetation itself to locate the mean high water line.[531]

The meander line has occasionally been used when it is impractical to locate the actual mean high water line. Meander lines are surveyed lines that run along the edge and usually slightly shoreward of a body of navigable water to determine the general land area. The

523. *See* notes 520-21 and accompanying text *supra*. *See also* Guth, *supra* note 6, at 36.
524. *See also* Guth, *supra* note 6, at 36.
525. Telephone conversation, *supra* note 518.
526. 2 A. SHALOWITZ, *supra* note 5, at 177-82. *See also* NOS Map, *supra* note 496.
527. Model Act § 3(2).
528. 2 A. SHALOWITZ, *supra* note 5, at 177.
529. NOS Map, *supra* note 496.
530. *Id. E.g.*, Guss, *Tidelands Management Mapping for the Coastal Plains Region*, 1972 PROCEEDINGS OF THE AM. SOC'Y OF PHOTOGRAMMETRY 251, 256 (Fall Convention).
531. 2 A. SHALOWITZ, *supra* note 5, at 450.

meander line of a particular piece of land will be a straight line or a series of straight lines connecting points or monuments on the shore.[532] Generally, unless a clear intent to make the meander line the boundary is shown, the water's edge is the actual boundary of meandered property.[533] However, there are situations, as exemplified by *Udall v. Oelschlaeger*,[534] in which boundaries of federal public domain lands are defined by reference to the meander line rather than by reference to tidal datums.

The *Oelschlaeger* decision involved federal lands located near the Alaskan seacoast. The case arose out of the government's refusal to approve the plaintiff's application for a patent under the federal homestead legislation. According to the government, the land in question had been previously withdrawn from entry by Department of Interior Public Land Order 576 that purported to withdraw from appropriation an area "parallel to and one mile distant from the line of mean high tide of Turnagain Arm," a tidal inlet. The Interior Department construed "the line of mean high tide" in the Order to mean the meander line, while the plaintiff maintained that the term referred to the mean high water line as defined by the Supreme Court in *Borax Consolidated Ltd. v. City of Los Angeles*.[535]

The lower court remanded the matter to the Department of the Interior with directions to utilize the *Borax* standard. On appeal, however, the court of appeals reversed, holding that the Interior Department's use of the line of "mean high tide" intended to refer to the meander line.[536] According to the court, the Department's interpretation was controlling for purposes of identifying the lands affected by its with-

532. Den v. Spalding, 39 Cal. App. 2d 623, 625, 104 P.2d 81, 83 (1st Dist. Ct. App. 1940). *See also* 2 A. SHALOWITZ, *supra* note 5, at 450.

533. Mitchell v. Smale, 140 U.S. 406, 414 (1891); Hardin v. Jordan, 140 U.S. 371, 380 (1891). The general statement of the rule is that "a meander line may constitute a boundary where so intended or where the discrepancies between the meander line and the ordinary high water line leave an excess of unsurveyed land so great as clearly and palpably to indicate fraud or mistake." Lopez v. Smith, 145 So. 2d 509, 515 (Fla. 1962).

534. 389 F.2d 974 (D.C. Cir. 1968).

535. 296 U.S. 10 (1935).

536. The land involved had not been surveyed. The area just to the north, however, had been surveyed and the points on that survey were used to define the area to be withdrawn. Public Land Order 576 described one of the boundaries of the withdrawn area as "Northwesterly, 11 miles along line of mean high tide of Turnagain Arm to meander corner on south boundary of section 32, T.12 N, R. 3W." According to the court, "Since the area to the north had been surveyed by the running of a meander line on its seaward side, the use of the base point of the 'meander corner' suggests that withdrawal order contemplated a continuance of the meander line down the coast to the south." 389 F.2d at 976.

drawal order.[537]

Courts have on occasion declared the meander line to be the property boundary where the water line was obscured by mangrove in cases in which the state presented no evidence as to the location of the mean high water line. *Trustees of the Internal Improvement Fund v. Wetstone*[538] involved an island meandered under the original government patent. The Florida Supreme Court, reasoning that it is the State's duty to establish the boundary between private and sovereignty lands, accepted the meander line as the boundary.[539] Decisions such as this should encourage the state to develop an accurate coastal mapping system, to avoid jeopardizing large areas of state-owned tideland.[540]

In Alaska, in a trespass case, the meander line was presumed substantially to indicate an obscured mean high water line.[541] It is interesting to note that the court did not hold that the meander line would be presumed the boundary for title purposes; there was no implication that the State would relinquish its claim to the tideland be-

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537. The court held that it must defer to the Secretary of the Interior's interpretation of his own regulations so long as that interpretation was not plainly unreasonable or unauthorized:

> The question for us, therefore, as it was for the District Court, is not whether plausible grounds can be advanced for each of the contending constructions, but whether the one espoused by the Secretary is beyond the bounds of reasonableness. If it is not, his view prevails, even though appellee's arguments are not without substance. This precedence derives from the rights which appropriately go with the great official responsibilities inherent in the administration of the public lands. We recognize them here.

389 F.2d at 976.

538. 222 So. 2d 10 (Fla. 1969).

539. The State, in fact, offered no evidence as to the boundary line. *Id.* at 11. Pointing out that the meander line was in places several hundred feet offshore in navigable waters, the dissent argued that the state had no authority to convey sovereignty lands except in the public interest. *Id.* at 14-19.

540. This decision gives the owner of property abutting tidelands two choices of a boundary line. If his meander line is shoreward of the mean high water line he can claim the mean high water line as the boundary. If, conversely, the meander line lies seaward of the mean high water line, he might be able to show that, owing to the lack of survey data, tide gauging stations and tidal bench marks, the old meander line should be the boundary of his property. *See* Florida First Nat'l Bank v. Trustees of Internal Improvement Fund, 36 Fla. Supp. 42 (Cir. Ct. Monroe County 1971); Maddox v. Trustees of Internal Improvement Fund, 37 Fla. Supp. 73 (Cir. Ct. Sarasota County 1970). For a criticism of the *Wetstone* decision see Note, 1 FLA. ST. L. REV., *supra* note 362, at 634-38.

541. Hawkins v. Alaska Freight Lines, Inc., 410 P.2d 992 (Alas. 1966). The purpose of the presumption was to determine whether a trespass had occurred in fact on certain private property. Since the trespass consisted of fill and road construction that had obliterated the actual water line, the court felt that it was unfair to require the property owner to produce evidence of the actual boundary.

low the mean high water line because of the difficulty of locating the actual boundary.[542]

Use of the meander line as an alternative to the mean high water line presents both practical and legal problems. The meander line may be highly inaccurate, reflecting errors in surveying or failing to reflect changes in the shoreline since the original survey.[543] If the meander line is seaward of the mean high water line the state may lose ownership and control of a valuable resource, while if the line is significantly shoreward of the mean high water line the riparian owner may lose some of his valuable riparian rights.[544]

Legally the meander line may be unacceptable as a standard boundary line because the private owner may not be deprived of his riparian rights to accretion without due process. Since meander lines do not fluctuate with changes in water levels or land contours, they are analogous to the type of fixed boundary attempted to be established by the State of Washington before such boundaries were declared unconstitutional in the *Hughes* and *Washington* decisions.[545] It is constitutionally questionable whether a fixed boundary along a coast could be established by a state, at least insofar as the boundary adversely affects the riparian owner.[546]

A meander line seaward of the mean high water line, however, may constitute a legal boundary. Washington has consistently recog-

542. *Id.*

543. A dramatic demonstration of the consequences of such an error is a series of legal events involving lands abutting Estero Bay, Florida. Following the *Wetstone* decision a complaint was filed to determine the boundary line and to quiet title to large quantities of mangrove-covered land in the Bay. Windsor v. Trustees of Internal Improvement Fund, No. 69-649 (Cir. Ct. Lee County, Fla., filed June 18, 1969). Claiming that the property consisted of mangrove swamp areas and that the mean high tide line could not be located with any real precision, the claimant offered two alternatives: (1) that the original federal government surveyed meander line be accepted as the boundary; (2) that the vegetation line be accepted as the boundary. The original meander line was obviously in error, crossing as it did stretches of navigable water and purporting to include large areas of sovereignty land in the original grant. Rather than risk the issue in court, the State settled with the landowner by conveying to him substantial amounts of sovereignty land in exchange for land under the open water of the bay. Settlement Agreement, Windsor v. Trustees of Internal Improvement Fund, No. 69-649 (Cir. Ct. Lee County, Dec. 8, 1970). A lawsuit has recently been filed by the Florida Secretary of Agriculture joined by a local conservation organization to attempt to set aside a deed from the State to Windsor based on the Settlement Agreement. Lee County Conservation Ass'n v. State, No. 74-1476 (Cir. Ct. Leon County, Fla., Aug. 19, 1974).

544. *See* Part II A *supra.*

545. *See* text accompanying notes 355-69 *supra.*

546. Bonelli Cattle Co. v. Arizona, 414 U.S. 313 (1973). *Bonelli* would appear to establish that the boundary of any property abutting on lands involved in the Submerged Lands Act is a federal question. *See* text accompanying notes 370-81 *supra.*

nized meander lines seaward of the mean high water line as the boundary line of upland property conveyed by government grant prior to statehood.[547] Washington's rule relies upon the theory that the State is free to convey its sovereignty land as it wishes.[548] The validity of this approach in other states, however, would depend upon their concept of the public trust doctrine. Since that doctrine is regarded as a judicial restraint on the power of the legislature to alienate tidelands except in the public interest,[549] the courts should be much less likely to recognize meander line boundaries which in effect give away sovereignty submerged lands.

Thus, the meander line does not appear to be a reasonable substitute for the mean high water line as a general rule. There is far too much at stake, given the contemporary value of the tidelands, to allow the desire for a simple solution to outweigh the need for a state to preserve its control over its natural resources.

A more promising approach may be to locate the mean high water line by the use of botanical data. In some areas the distribution of the types of vegetation makes it possible to establish a line approximating the mean high water line. With respect to fresh water boundaries, the line devoid of vegetation has been used as a test for the line of ordinary water.[550] A similar test, establishing a line below which terrestrial vegetation does not grow, has occasionally been used to establish the tidal boundary.[551] The problem in the marshes and mangrove stands is more complicated, however, since the vegetation involved grows in salt water and does not leave a clean bare line at the water's edge. Proposed tests for determining the mean high water line in these areas

547. *See, e.g.*, Mercer Island Beach Club v. Pugh, 53 Wash. 2d 450, 334 P.2d 534 (1959).

548. Washington interprets the "disclaimer" clause of its Constitution, WASH. CONST. art. 17, § 2, as relinquishing all interest in tidelands patented before statehood. Cogswell v. Forrest, 14 Wash. 1, 43 P. 1098 (1896); Scurry v. Jones, 4 Wash. 468, 30 P. 726 (1892). This rule has been applied only in cases involving Puget Sound, bays, lakes and waters treated as bays. Smith Tug & Barge Co. v. Columbia-Pacific Towing Corp., 78 Wash. 2d 975, 482 P.2d 769, *cert. denied*, 404 U.S. 829 (1971) and cases cited therein.

549. Note, *Maryland's Wetlands: The Legal Quagmire*, 30 MD. L. REV. 240, 261 (1970). *See* Sax, *supra* note 20, at 557-65.

550. Howard v. Ingersoll, 54 U.S. (13 How.) 380 (1851); United States v. Claridge, 279 F. Supp. 87 (D. Ariz. 1967); Willis v. United States, 50 F. Supp. 99 (S. D.W. Va. 1943); St. Louis, I.M. & S. Ry. v. Ramsey, 53 Ark. 314, 13 S.W. 931 (1890); Wilcox v. Pinney, 250 Iowa 1378, 98 N.W.2d 720 (1959); Diana Shooting Club v. Hursting, 156 Wis. 261, 145 N.W. 816 (1914).

551. County of Hawaii v. Sotomura, 517 P.2d 57 (Hawaii 1973); Harkins v. Del Pozzi, 50 Wash. 2d 237, 310 P.2d 532 (1957); *cf.* Begnaud v. Grubb & Hawkins, 209 La. 826, 25 So. 2d 606 (1946) (using cypress growth to determine navigable waters).

are based on the salt-water tolerances of varieties of marsh grasses[552] and mangroves.[553] Some claim that mapping of a marsh by aerial photography, delineating the limits of the various grasses, will show the mean high water line with greater accuracy than a field survey.[554] There has been no similar claim that the varieties of mangrove can be distinguished by aerial photography.

Such vegetation tests have not been fully accepted as evidence by the courts. One New York court has used marsh grass growths to determine the general area in which the average high water line could be found.[555] However, the court noted that the grasses react to a change in tidal patterns over a period of several growing seasons.[556] If this is true, the vegetation obviously cannot mark a stable line over a period of 18.6 years.[557] In a later case in the same New York court, evidence by a state biologist as to the location of the mean high water line by vegetation maps was viewed as inconclusive.[558] The court apparently assumed that vegetation does not provide an exact location but can only show the general location of the mean high water line.

Despite questions as to their long-range reliability, vegetation tests may be usefully combined with mean high water line point locations established by field surveys to provide a physical interpolation of the line between the points. If the vegetation of a particular area has been well studied, and the bottom configuration is uniform, perhaps as few points as one per one-half mile of marshland or mangrove will need

552. In a South Carolina project the mean high water line was found to be bracketed by the high marsh grass species and one of two salt water species, *spartina alterniflora* or annual *salicornia sp.* Guss, *supra* note 530, at 251.

553. *See* J. DAVIS, THE ECOLOGY AND GEOLOGICAL ROLE OF MANGROVES IN FLORIDA 303-417 (Carnegie Institution of Washington Pub. No. 517, 1940).

554. Guss, *supra* note 530, at 256.

555. Dolphin Lane Associates, Ltd. v. Town of Southampton, 72 Misc. 2d 868, 339 N.Y.S.2d 966 (Sup. Ct. 1971). The court considered the grasses *spartina alterniflora* and *spartine patents* to indicate the area in which daily tide flow occurs. The strip of land where both types grew was held to be the general area of the mean high water line. No greater accuracy was attempted by the court since the parties had agreed to accept a metes and bounds description once the general boundary was established.

556. *Id.* at __, 339 N.Y.S.2d at 985. This distrust of the vegetation boundary has been challenged. *See* Guss, *supra* note 530, at 256.

557. The 18.6-year period is required to incorporate all astronomic effects on the tides. If the grasses are shifting as the tide shifts through its patterns with perhaps a lag of a few growing seasons, the vegetation is no more accurate than high tide observation during the growing cycle of the grass.

558. State v. Bishop, 75 Misc. 2d 787, 348 N.Y.S.2d 990 (Sup. Ct. 1973). The case involved a state claim to the marshland up to the mean high tide line as sovereignty land. The court ruled that the evidence as to the mean high tide line was irrelevant since the New York test for the boundary between public and private tidelands is the navigability of the water overlying the land.

to be established.[559] The method would obviously more accurately mark the actual mean high water line than straight lines drawn between surveyed points—the method used in establishing a meander line. Moreover, even if the vegetation were not acceptable as evidence of the actual line, it might be a useful tool to prevent gross errors in locating the mean high water line.

The problem of determining the mean high water line where the shore has been filled deserves some mention. Neither conventional survey techniques nor observation of vegetation can help in this situation. Use of the meander line is one approach that has already been discussed.[560] Another approach that has been favorably mentioned by the courts is drilling through the fill, extracting core samples, and from these samples obtaining a geologist's opinion as to the location of the mean high water line before the fill activity occurred.[561] However, no court has established the mean high water line on this basis alone. In a case which required determining the ordinary high water mark as of an earlier date on a fresh water river, an Iowa court considered a geologist's evidence together with evidence from botanists and data gathered from a river gauge.[562] No one method was considered conclusive. Recently a Delaware court seemed willing to accept geologist's core samples as evidence of the mean low water line; however, a request to conduct the necessary drillings was denied for reasons of estoppel.[563] The core sample method, if proven accurate, could be a useful supplement to other coastal mapping techniques in artificially filled areas.

Such techniques include aerial photography. Federal, state, and private firms have conducted aerial surveys, particularly in coastal regions, for about 50 years. Research of such courses will frequently produce high-quality photographs that in themselves or when compared to current tidal controlled aerial photography will indicate the extent of artificial fill. Survey records, including those used in the preparation of NOS nautical charts and geological survey quadrangles, as well as those prepared by local surveyors, county land records, records of historical societies, newspapers and recollections of local residents have

559. Testimony of J. Guth, *In re* Committee Meeting Estero Bay Land Transactions, Committee on Natural Resources, at 241 (Lee County, Fla., Nov. 15, 1973).

560. *See* notes 532-49 and accompanying text *supra.*

561. Hawkins v. Alaska Freight Lines, Inc., 410 P.2d 992 (Alas. 1966).

562. City of Cedar Rapids v. Marshall, 199 Iowa 1262, 203 N.W. 932 (1925).

563. State *ex rel.* Buckson v. Pennsylvania R.R., 273 A.2d 268 (Del. 1971).

on occasion been effectively utilized to reconstruct the natural land configuration.[564]

(c) *Surveys in areas of diminished tidal influence*

When the bed of a tidally-affected waterbody is owned by the state, privately-owned upland property may extend to: (1) the mean high water line; (2) the mean water level line; or (3) the ordinary high water mark. Selection of the appropriate boundary line, however, may present both serious practical and legal problems.

(i) The mean high water line

In theory, the mean high water line is normally utilized for boundary purposes in tidal waters where the bed is publicly owned. Because tidal phenomena reflect cyclical astronomic conditions,[565] elevations based solely on tidal data are usually permanent and recoverable.[566] The introduction of nontidal constituents into the calculation process, however, may compromise the reliability of the vertical datum.

The masking of the tidal effect by nontidal forces such as seiche is an example of this condition. Seiche, which occurs in bays and harbors, is the oscillation of water due to barometric pressure, earthquakes, and other nonastronomic forces.[567] Arguably, seiche should be ignored in determining mean high water,[568] and there is some legal support for this position.[569]

(ii) The mean water level line

In those areas where the range of the tide is small or where tidal effects are masked by meteorological conditions or fresh-water runoff, NOS computes the mean water level instead of the mean high water

564. *See, e.g.*, United States v. Stoeco Homes, Inc., 498 F.2d 597, 603 (3d Cir. 1974); United States v. Keevan & Son, Inc., Civil No. 74-69 (S.D. Fla., June 27, 1974).

565. There is, however, evidence in many areas of a rise in mean sea level due to subsidence of the ocean floor and other causes. Levin & Cronan, *The Impending Submergence of the Coastal Zone*, 1973 PROCEEDINGS OF THE AM. SOC'Y OF PHOTOGRAMMETRY 57, 57-58 (Fall Convention). This may affect the long-term accuracy of the vertical elevation. H. MARMER, *supra* note 77, at 87.

566. A. SHALOWITZ, *supra* note 5, at 89.

567. *See* Corker, *Where Does the Beach Begin, and to What Extent is This a Federal Question*, 42 WASH. L. REV. 33, 64 (1966); H. MARMER, *supra* note 77, at 39.

568. H. MARMER, *supra* note 77, at 41-42.

569. City of Los Angeles v. Borax Consol. Ltd., 20 F. Supp 69 (S.D. Cal. 1937), *aff'd* 102 F.2d 52 (9th Cir. 1939). On appeal, the court of appeals decided the case on other grounds. 102 F.2d at 57-58.

datum.[570] This elevation is determined by averaging the height of the water level at hourly intervals over an appropriate period of time.[571] The intersection of this datum with the shore is known as the mean water level line. Since the mean water level line may appear on NOS maps produced in conjunction with state coastal mapping programs, some discussion of the legal validity of its use as a property boundary is necessary.

In some bays and lagoons, where the range of the tide does not exceed a tenth of a foot, the daily or semidaily high and low waters cannot be distinguished with sufficient accuracy to meet NOS standards. In such situations, the mean water level is much easier to obtain and, as a practical matter, does not differ significantly from either the mean high or mean low water datums. Since the vertical elevations of mean high water and mean water level are virtually identical, it follows that the mean water level line could serve as the legal equivalent of the mean high water line.

However, where the tidal influence in a tidal river or stream is masked by interference from fresh water runoff, a mean water level elevation should not be used for boundary purposes. Fresh water runoff, even where it results from seasonal flooding, is not a cyclical or recurrent condition in any regular sense. More importantly, it is not offset by other phenomena in the same way as are the purely tidal constituents that make up mean high water. Consequently, the inclusion of elevations caused primarily by fresh water runoff in the mean water level datum would create the same forms of inaccuracy in the vertical datum as the presence of seiche in the mean high water elevation. Therefore, if the mean water level is to be used as the equivalent of mean high water, water levels caused by runoff should be eliminated from the computation of this datum. If it is not practical to do so, arguably, the watercourse should be treated as fresh water. This would require the use of the ordinary high water mark concept for boundary determination purposes.

(iii) The ordinary high water mark

The ordinary high water mark is the usual boundary between the bed of a navigable watercourse and the adjacent upland.[572] According

570. W. HULL, *supra* note 4, at 3.

571. P. SCHUREMAN, *supra* note 76, at 36.

572. In the absence of special circumstances, the title of landowners along nonnavigable streams extends to the thread of the stream. Maloney & Plager, *Florida's*

to the weight of authority, the ordinary high water mark is the line that the water impresses upon the soil by covering it for sufficient periods to deprive it of vegetation and to destroy its value for agriculture.[573] Unlike the mean high water line or the mean water level line, the ordinary high water mark does not represent the intersection of a particular vertical datum with the shore. Instead, it is a physical mark caused by the action of the water on the land, and refers to a point at which the character of the soil and vegetation, if any, differs from that of the upland.[574]

Moreover, the ordinary high water mark refers to the usual or ordinary water level and does not extend to lands tempoarily submerged by flood waters.[575] The federal courts have also rejected claims that the ordinary high water mark of a river is the level of annual flooding.[576] Thus, it seems clear that the mean water level line cannot be used in lieu of the ordinary high water mark for boundary determination purposes in fresh waters. For example, if flood levels are included along with usual water levels in the calculation of the mean water level, the resulting mean water level line may be located a considerable distance landward of the ordinary high water mark. It follows, therefore, that the freshwater boundary cannot be determined by means of a mathematical average of the daily water levels.

(3) Other Statutory Provisions

The Model Act requires that surveys be made only by licensed surveyors or by approved federal employees.[577] It also requires that copies of all private coastal surveys be sent to the agency within ninety days after completion if they are to be recorded or used in any judicial

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Streams—Water Rights in a Water Wonderland, 10 U. FLA. L. REV. 294, 295 (1957); Annot., 74 A.L.R. 597 (1931). "The 'thread of the stream' when called for as a boundary line for private estates, 'is the middle line between shores, irrespective of the depth of the channel, taking them in the natural and ordinary stage of the water, at medium height, neither swollen by freshets nor shrunk by droughts.'" State v. Muncie Pulp Co., 119 Tenn. 47, 78, 104 S.W. 437, 445 (1907), *quoting* Branham v. Bledsoe Creek Turnpike Co., 69 Tenn. 704, 706 (1878).

573. Howard v. Ingersoll, 54 U.S. (13 How.) 380, 415 (1851).

574. Borough of Ford City v. United States, 345 F.2d 645, 648 (3d Cir.), *cert. denied*, 382 U.S. 902 (1965).

575. Paine Lumber Co. v. United States, 55 F. 854, 864 (C.C.E.D. Wis. 1893).

576. United States v. Claridge, 279 F. Supp. 87, 91 (D. Ariz. 1967), *aff'd per curiam*, 416 F.2d 933 (9th Cir. 1969), *cert. denied*, 397 U.S. 961 (1970); Willis v. United States, 50 F. Supp. 99 (S.D.W. Va. 1943), *aff'd*, 141 F.2d 214 (4th Cir. 1944); Kelley's Creek & N.R.R. v. United States, 100 Ct. Cl. 396 (1943).

577. Model Act § 12.

or administrative proceeding.[578] This will enable the agency to obtain and preserve this type of useful data.

There are no criminal sanctions in the Model Act. The Act's success substantially depends on the cooperation of the professional surveyors. A powerful enforcement tool, however, is a provision which declares that no map or survey concerned with coastal boundaries and made after the adoption of the Act shall be admissible as evidence in any judicial or administrative proceeding unless it complies with the Act's requirements.[579]

D. The Coastal Mapping Program

Section 6 of the Model Act directs the agency to conduct a comprehensive program of coastal boundary mapping.[580] The program will involve the determination of local tidal datums, such as mean high water, at appropriate intervals along the entire coastline of the state. In addition, the agency will publish a series of photogrammetic maps of the state's coastline, of suitable scale, on which the mean high water line will be represented.[581]

In connection with the mapping program, the agency may serve as the coordinating state agency for any program of tidal surveying or coastal mapping conducted by the federal government.[582] Moreover, the agency may contract with any federal, state or local agency or with private parties for the performance of surveys, studies, investigations, mapping or related activities associated with the program.[583] The Act contemplates, but does not specifically require, a joint federal-state program in which most of the actual surveying and mapping activities would be be performed by NOS.[584]

The program authorized by the Model Act was inspired by a joint coastal mapping program currently sponsored by NOS and the State of Florida. The program originated in a 1969 agreement between the State of Florida and the NOS for establishing tidal datum planes and

578. *Id.* § 13.
579. *Id.* § 16.
580. "The [agency] is authorized and directed to conduct a comprehensive program of coastal boundary mapping with the object of providing accurate surveys of the coastline of the state at the earliest possible date." *Id.* § 6.
581. Maps produced under the NOS-Florida coastal mapping program are published at a 1:10,000 scale. A. Powell, *supra* note 485, at 5.
582. Model Act § 5(b).
583. *Id.* at § 5(d).
584. A. Powell, *supra* note 485, at 8.

mapping the Florida coastal zone. Under this program NOS assumed responsibility for establishing tide stations, determining tidal datums, and producing, printing, and distributing a series of maps which accurately portray the mean low-water line and, insofar as practical, the mean high-water line.

The tidal datums and maps are to be used by Florida as source data for selecting baseline points to establish coastal boundaries including seaward boundaries and boundaries between sovereignty land and upland subject to private ownership. For NOS, the survey will furnish base maps and related data for its marine charting program.[585]

Since public acceptance is largely dependent on the accuracy, availability and official status of the maps, the proposed act has dealt with each of these matters. The question of accuracy has been mentioned before in connection with survey methodology. The procedure by which tidal elevations are determined in connection with the mapping program is the most accurate practicable method available,[586] and the maps themselves conform to national map accuracy standards.[587] Moreover, in order to insure the continuing reliability of the maps, the agency must review its data at least every twenty-five years, and where necessary, publish updated and revised maps.[588] In addition, when natural processes or human activities cause sudden shoreline alteration, the agency is authorized to investigate and issue revised maps.[589]

To insure that the maps will be readily available to the general public, the Act provides for their publication and requires that they be filed among the public land records of each affected county.[590]

The proposed act also gives official sanction to coastal maps produced under the program. Upon formal adoption and publication by

585. W. HULL, *supra* note 4, at 2.

586. NOS has undertaken to compute the vertical datum within a tolerance of 0.1 foot. *Id.* at 3.

587. Model Act § 7. " 'National map accuracy standards' means a set of guidelines published by the office of management and budget of the United States to which maps produced by the United States government usually adhere." *Id.* § 3(21). *See* L. SWANSON, TOPOGRAPHIC MANUAL, Part II (U.S. Coast & Geodetic Survey Spec. Pub. No. 249, 1949).

588. Model Act § 9(1).

589. *Id.* § 9(2). The agency may also publish supplemental maps of a larger scale. *Id.* § 9(3). Revised or large-scale supplemental maps may be designated "approved coastal zone maps" following action by the agency in accordance with the procedures established in section 8. *Id.* § 9(4).

590. *Id.* § 8. About 400 copies of each map are published by NOS in connection with the NOS-Florida coastal mapping program. Maps may be purchased from NOS for $2.50 apiece.

the agency, the maps are designated "approved coastal zone maps."[591] Section 10(1) expressly provides for the admissibility of approved coastal zone maps as evidence in all judicial or administrative proceedings throughout the state.[592] This provision avoids the possible requirement that a cartographer from NOS attend each trial or administrative proceeding to lay the foundation for the admission of a map or maps.[593] Since the mean high water line, as depicted on the maps, may vary as much as sixteen feet from the actual mean high water line,[594] landowners who wish to ascertain their coastal boundaries with greater precision should make a field survey. When performed in accordance with the provisions of section 14 of the Model Act, the results of such a survey may be introduced as evidence to contest the accuracy of an approved coastal zone map.[595]

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591. *Id.* § 8. The Florida Coastal Mapping Act of 1974, ch. 74-56, § 8, [1974] Fla. Laws 37, provides for a public hearing prior to formal approval by the agency.

> (1) Upon completion of a map or series of maps, the department shall transmit a copy of the map or maps to the clerk of the circuit court for the county in which the land shown on the map is located. In addition, the department shall publish in a newspaper of general circulation in the affected area at least once a week for four consecutive weeks a notice that a copy of the proposed map or maps is on file in the said clerk's office, and that a public hearing shall be held at a specified time and place as provided in subsection (2).
> (2) Before a proposed map shall become effective, the department shall hold a public hearing in the county or counties in which the land shown on the map is located.
> (3) After such public hearing the department may approve the proposed map with or without amendments or may withdraw it for further study.
> (4) The decision of the department shall be subject to judicial review as provided in chapter 120, Florida Statutes.
> (5) Upon approval by the department these maps shall be known as "approved coastal zone maps" and copies thereof shall be filed among the public land records of all affected counties.

592. "Approved coastal zone maps shall be admissible as evidence in proceedings before any court, tribunal or agency of state or local government. The location of the mean-high or mean-low water lines represented on such maps may be more precisely identified by the introduction of field surveys made in accordance with the standards and procedures set forth in sections 13 through 15 of this act." Model Act § 10(1). This provision was not included in the Florida Coastal Mapping Act as a result of objections at the legislative hearings, but the authors feel its inclusion is desirable and fully justified.

593. Statutes which provide for exceptions to the hearsay rule for official records may eliminate the requirement for an in-court appearance by a cartographer in federal courts. *See* 28 U.S.C. § 1733 (1970); FED. R. CIV. P. 44. *See also* FLA. STAT. § 92.32 (1973). *But see* Florida S. Ry. v. Parsons, 33 Fla. 631, 15 So. 338 (1894); AM. JUR., PROOF OF FACTS 602 (1960); 13 FLA. JUR. *Evidence* § 298 (1957).

594. National Map Accuracy Standards require maps of a scale of 1:10,000 to be accurate to within 25 feet. NOS vouches map accuracy of this scale of within 16 feet. NOS map, *supra* note 496. Field surveys by NOS to check the accuracy of the maps in Florida have so far revealed a maximum error of within 9 feet. Testimony of Commander Wesley V. Hull, NOAA, Chief, Coastal Mapping Division, Nation Ocean Survey, Governor's Coastal Mapping Conf., Tallahassee, Florida (Dec. 15, 1973).

595. *See* Model Act § 10(1).

Where the location of the mean high water line is obscured by vegetation, as in the case of marshland or mangroves, NOS normally maps only the apparent shoreline.[596] The apparent shoreline represents "the intersection of the mean high-water datum with the outer limits of vegetation and appears to the navigator as the shoreline."[597] Where vegetation is quite extensive, the actual mean high water line may be considerably landward of the apparent shoreline.[598] Therefore, the apparent shoreline, as depicted on the maps, has no legal significance and is not treated as a property line under the Model Act.[599]

V. CONCLUSION

The period of uncoordinated and wasteful use of coastal resources appears to be ending. Government at all levels is responding to public concern over the coastal environment by assuming a greater role in the process of coastal zone management. A viable regulatory effort, however, requires a rational administrative structure, a framework for planning and policy making, and an effective implementation scheme.[600]

An essential prerequisite to the development of such a program is the determination of the respective legal interests of both private landowners and the public in coastal areas. This involves a consideration of both the rights and limitations inherent in the nature of coastal property and the physical delimitation of private and public ownership. The former subject is embraced within the notion of riparian rights in the case of private property and within the concept of the public trust doctrine in the case of state-owned submerged lands. This article has concerned itself primarily with the latter topic—the problem of coastal boundaries—and will conclude with a brief discussion of the relationship between coastal mapping and an overall management program. The accurate determination and representation of coastal boundaries is an important aspect of both the planning and implementation phases of coastal zone management.[601] In the planning process, the maps are necessary to represent existing or proposed land use patterns. They

596. 2 A. SHALOWITZ, *supra* note 5, at 177-82.
597. Model Act § 3(2).
598. *See* 2. A. SHALOWITZ, *supra* note 5, at 176-77.
599. "Where approved coastal zone maps do not designate the mean high-water line but instead depict an apparent shoreline, the apparent shoreline is not intended to represent the mean high-water line. In such cases the mean high-water line may be located by field surveys of the type referred to in subsection (1) above." Model Act § 10(2).
600. Schoenbaum, *Public Rights and Coastal Zone Management*, 51 N.C.L. REV. 1, 23-30 (1972).
601. W. HULL, *supra* note 4.

may also be used to depict biological and mineral resources, and to locate problem areas. This information is also required for planning in connection with beach nourishment and land acquisition activities.

Maps and survey data is also required for regulatory purposes. At the federal level, for example, the administration of the dredge and fill permit programs under the Rivers and Harbors Act[602] generates a great demand for such information. About 17,000 permit applications will be processed this year,[603] and in each, the limit of the Corps of Engineers' jurisdiction, the mean high water line, must be ascertained and depicted.[604] Similar data may be utilized by the Environmental Protection Agency for the purpose of enforcing the provisions of the Federal Water Pollution Control Act.[605] The administration of comparable programs at the state level also requires accurate coastal boundary data, as does the implementation of coastal construction set-back line requirements, shoreline zoning, and wetland protection provisions.

This article has examined some of the difficulties associated with the ascertainment of coastal boundaries. It is hoped that the proposed Model Act will provide solutions to some of these problems. The authors recommend that the states: (1) define coastal boundaries for purposes of private ownership in terms of the mean high or mean low water line which has a scientifically recognized meaning; (2) require the development and use of a coastal survey methodology which will insure that property boundaries are determined with all possible accuracy; and (3) provide for a comprehensive program of coastal zone mapping. The implementation of these proposals, coupled with an effective coastal zone management program, cannot fail to contribute to a better utilization of the nation's coastal resources.

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602. 33 U.S.C. §§ 401-66 (1970).

603. H. Dolan, Coastal Problems Related to Water Levels (presentation to Seventh GEOP Research Conf., Ohio State Univ. June 6-7, 1974).

604. While the Corps utilizes every available source of information in checking the accuracy of permit applications, actual tidal observations are necessary for proper decision making. While the use of the Sea Level Datum (National Geodetic Datum) elevation in near shore areas is inadequate for these purposes, if no other data are available, the Corps uses it. *Id.* at 4-5.

605. 33 U.S.C. §§ 1251-1376 (Supp. 1974). *But see* United States v. Holland, 373 F. Supp. 665 (M.D. Fla. 1974). The Environmental Protection Agency in the *Holland* case argued that filling operations in the waters of Papy's Bayou near St. Petersburg, Florida, violated the provisions of the Federal Water Pollution Control Act. In that legislation "navigable waters" were defined as "waters of the United States, including the territorial seas." 33 U.S.C. § 1362(7) (Supp. 1974). The court held that the discharging of sand, dirt and dredge spoil on land which was periodically inundated with the waters of Papy's Bayou violated the Act even though the land was located above the mean high-water line.

VI APPENDIX

MODEL COASTAL MAPPING ACT

An act relating to coastal mapping; providing definitions; providing powers and duties of the [agency], providing a comprehensive and continuous program of coastal boundary mapping which will permit accurate surveys; providing standards for establishment of local tidal datums and methods of determining mean high-water and mean low-water lines; providing for admissibility as evidence; providing for severability; providing an effective date.

Be It Enacted by the Legislature of the State of ————————:

Section 1. Short title.—This act shall be cited as the "[Name of state] coastal mapping act of [year]."

Section 2. Declaration of policy.—The legislature hereby declares that accurate maps of coastal areas are required for many public purposes, including, but not limited to, the promotion of marine navigation, the enhancement of recreation, the determination of coastal boundaries, and the implementation of coastal zone planning and management programs by state and local governmental agencies. Accordingly, a state coastal mapping program is declared to be in the public interest. The legislature further recognizes the necessity of uniform standards and procedures with respect to the establishment of local tidal datums and the determination of the mean high-water and mean low-water lines, and therefore directs that such uniform standards and procedures be developed.

Section 3. Definitions.—The following words, phrases or terms used herein, unless the context otherwise indicates, shall have the following meanings:

(1) "Agency" means [Specify agency which will administer the act].

(2) "Apparent shoreline" means the line drawn on a map or chart in lieu of the mean high-water line in areas where the mean high-water line may be obscured by marine vegetation. This line represents the intersection of the mean high-water datum with the outer limits of vegetation and appears to the navigator as the shoreline.

(3) "Approved coastal zone map" means a map approved by the [agency].

(4) "Comparison of simultaneous observations" means a method of determining mean values by comparison of short-period observations

at a station with simultaneous observations made at a station for which mean values, based on long-period observations, are available.

(5) "Control tide station" means a place so designated by the [agency] or the national ocean survey at which continuous tidal observations have been taken or are to be taken over a minimum of nineteen years to obtain basic tidal data for the locality.

(6) "Datum" means a reference point, line, or plane used as a basis for measurements.

(7) "Datum plane" means a surface used as reference from which heights or depths are reckoned. The plane is called a tidal datum when defined by a phase of the tide, for example, high water or low water.

(8) "Demarcation" means the act of setting and marking limits or boundaries on the ground.

(9) "Diurnal tides" means tides having a period or cycle of approximately one tidal day.

(10) "Foreshore" means the strip of land between the mean high-water and mean low-water lines that is alternately covered and uncovered by the flow of the tide.

(11) "Geodetic bench mark" means a permanently monumented and precisely referenced and described mark, usually a bronze tablet or copper or bronze bolt, leaded or cemented into a masonry structure, which is established to give a definite high point on the monument to which geodetic elevations are referred.

(12) "Interpolated water elevation" means a point between two adjacent tide stations where the water elevation has been determined by interpolation from established datums at the two tide stations.

(13) "Leveling" means the operation of determining differences of elevation between points on the surface of the earth; the determination of the elevations of points relative to some arbitrary or natural level surface called a datum.

(14) "Local tidal datum" means the datum established for a specific tide station through use of tidal observations made at that station.

15) "Mean-high water" means the average height of the high waters over a nineteen-year period; or for shorter periods of observations, the average height of the high waters after corrections are applied to eliminate known variations and to reduce the result to the equivalent of a mean nineteen-year value.

(16) "Mean high water line" means the intersection of the tidal plane of mean high water with the shore.

(17) "Mean low-water" means the average height of the low waters over a nineteen-year period; or for shorter periods of observations, the average height of low waters after corrections are applied to eliminate known variations and to reduce the result to the equivalent of a mean nineteen-year value.

(18) "Mean low-water line" means the intersection of the tidal plane of mean low water with the shore.

(19) "Mean range difference" means the variation of the mean range of the tide at two different tide stations.

(20) "Mixed tide" means the type of tide in which the presence of a diurnal wave is conspicuous by a large inequality in either the high or low water heights with two high waters and two low waters usually occurring each tidal day. The name is usually applied to the tides intermediate to those predominantly diurnal and those predominantly semidiurnal.

(21) "National map accuracy standards" means a set of guidelines published by the office of management and budget of the United States to which maps produced by the United States government usually adhere.

(22) "Nineteen-year tidal cycle" means the period of time generally reckoned as constituting a full tidal cycle.

(23) "Nonperiodic forces" means those forces that occur without regard to a fixed cycle.

(24) "Photogrammetry" means the science of making precise measurements from photographs.

(25) "Semidiurnal tides" means tides having a period of approximately one-half a tidal day.

(26) "Tidal bench mark" means a standard disk or other acceptable fixed point in the general vicinity of a tide station used for the purpose of preserving tidal information, to which the tide staff at the tide station and the tidal datums determined from observations at the tide station are originally referred.

(27) "Tidal datum" means a plane of reference for elevations determined from the rise and fall of the tides.

(28) "Tidal day" means the time of the rotation of the earth with respect to the moon, or the interval between two successive upper transits of the moon over the meridian of a place.

(29) "Tide" means the periodic rising and falling of the waters of the earth that result from the gravitational attraction of the moon and the sun acting upon the rotating earth.

(30) "Tide station" means a place at which continuous tide observations have been taken or are to be taken to obtain tidal data for the locality.

(31) "Time difference" means the variation in time between the occurrences of the same phase of the tide at two tide stations.

Section 4. Legal significance of the mean high-water line.—

(1) The mean-high water line [along the shore of land immediately bordering on navigable waters] is recognized and declared to be the boundary between the foreshore owned by the state in its sovereign capacity and upland subject to private ownership, provided, however, that no provision of this act shall be deemed to constitute a waiver of state ownership of sovereignty submerged lands, nor shall any provision of this act be deemed to impair the title to privately-owned submerged lands validly alienated by the state or its legal predecessors.

(2) No provision of this act shall be deemed to modify the common law of this state with respect to the legal effects of accretion, reliction, erosion or avulsion.

Section 5. Powers and duties of the [agency].—

(1) The provision of this act shall be administered by the [agency]

(2) In addition to such powers as may be specifically delegated to it under the provisions of this act, the [agency] is authorized to perform the following functions:

(a) To coordinate the efforts of all public and private agencies and organizations engaged in the making of tidal surveys and maps of the coastal areas of this state with the object of avoiding unnecessary duplication and overlapping;

(b) To serve as a coordinating state agency for any program of tidal surveying and mapping conducted by the federal government;

(c) To assist any court, tribunal, administrative agency, or political subdivision, and to make available to them, information regarding tidal surveying and coastal boundary determinations;

(d) To contract with federal, state or local agencies or with private parties for the performance of any surveys, studies, investigations or mapping activities, for preparation and publication of the results thereof, or for other authorized functions related to the objectives of this act;

(e) To develop permanent records of tidal surveys and maps of the state's coastal areas;

(f) To develop uniform specifications and regulations for tidal surveying and mapping coastal areas of the state;

(g) To collect and preserve appropriate survey data from coastal areas; and

(h) To act as a public repository for copies of coastal area maps and to establish a library of such maps and charts.

Section 6. Authorization of coastal mapping program.—The [agency] is authorized and directed to conduct a comprehensive program of coastal boundary mapping with the object of providing accurate surveys of the coastline of the state at the earliest possible date.

Section 7. Mapping standards.—All maps produced under the provisions of this act shall conform at least to minimal national map accuracy standards.

Section 8. Approval of maps by the [agency].—Maps produced under the provisions of this act shall be designated as "approved coastal zone maps" upon adoption and publication by the [agency] and copies of such maps shall be filed among the public land records of each affected county.

Section 9. Revised and supplemental maps.—

(1) The [agency] shall endeavor to maintain the accuracy of its mapping program by reviewing its data at least every twenty-five years, and where necessary, issuing revised approved coastal zone maps.

(2) Any private person or government official may advise the [agency] in writing of any instance in which significant shoreline alteration has occurred as the result of natural conditions or human activities. Upon notification thereof, or on its own initiative, the [agency] may investigate such cases and, where appropriate, authorize the production of a revised approved coastal zone map of the affected area.

(3) Where appropriate and when needed or desirable for particular areas, the [agency] may publish supplemental maps of a scale larger than the standard scale.

(4) Revised or larger scale maps shall become approved coastal zone maps following approval by the [agency] in accordance with the provisions of section eight.

Section 10. Evidentiary effect of approved coastal zone maps.—

(1) Approved coastal zone maps shall be admissible as evidence in proceedings before any court, tribunal or agency of state or local

government. The location of the mean-high or mean-low water lines represented on such maps may be more precisely identified by the introduction of field surveys made in accordance with the standards and procedures set forth in sections 13 through 15 of this act.

(2) Where approved coastal zone maps do not designate the mean high-water line but instead depict an apparent shoreline, the apparent shoreline is not intended to represent the mean high-water line. In such cases the mean high-water line may be located by field surveys of the type referred to in sub-section (1) above.

Section 11. Standards and procedures; applicability.—The establishment of local tidal datums and the determination of the location of the mean high-water line or the mean low-water line, whether by federal, state or local agencies or private parties, shall be made in accordance with the standards and procedures set forth in sections 13 through 15 of this act and in accordance with supplementary regulations promulgated by the agency.

Section 12. Work to be performed only by authorized personnel. —The establishment of local tidal datums and the determination of the location of the mean high-water line or the mean low-water line shall be performed by qualified personnel licensed by the state or by representatives of the United States Government when approved by the [agency].

Section 13. Notification to [agency].—Any surveyor undertaking to establish a local tidal datum and to determine the location of the mean high-water line or the mean low-water line shall submit a copy of the results thereof to the [agency] within ninety days after the completion of such work if the same is to be recorded or submitted to any court or agency of state or local government.

Section 14. Standards for establishment of local tidal datums.—

(1) Unless otherwise allowed by this act or regulations promulgated hereunder, a local tidal datum shall be established from a series of tide observations taken at a tide station established in accordance with procedures approved by the [agency]. In establishing such procedures full consideration will be given to the national standards and procedures established by the National Ocean Survey.

(2) Records acquired at control tide stations, which are based on mean nineteen-year values, comprise the basic data from which tidal datums shall be determined.

(3) Observations at a tide station other than a control tide station

shall be reduced to mean nineteen-year values through comparison with simultaneous observations at the appropriate control tide station. The observations shall be made continuously and shall extend over such period as shall be provided for in [agency] regulations.

(4) When a local tidal datum has been established, it shall be preserved by referring it to tidal bench marks in the manner prescribed by the [agency].

(5) A local tidal datum may be established between two tide stations by interpolation where the time and mean range differences of the tide between the two tide stations are within acceptable standards as determined by the [agency]. The methods for establishing the local tidal datum by interpolation shall be prescribed by regulations of the [agency]. Local tidal datums established in this manner shall be recorded with the [agency].

(6) A local tidal datum property established through the use of continuous tide observations meeting the standards described in this section shall be presumptively correct when it differs from a local tidal datum established by interpolation.

(7) The [agency] may approve the use of tide observations made prior to the effective date of this act for use in establishing local tidal datums.

Section 15. Determination of mean high-water line or mean low-water line.—The location of the mean high-water line or the mean low-water line shall be determined by methods which are approved by the [agency] for the area concerned. Geodetic bench marks shall not be used unless approved by the [agency].

Section 16. Admissibility of maps and surveys.—No map or survey prepared after the effective date of this act and purporting to establish local tidal datums or to determine the location of the mean high-water line or the mean low-water line shall be admissible as evidence in any court, administrative agency, political subdivision, or tribunal in this state unless made in accordance with the provisions of this act by persons described in section 12 hereof.

Section 17. Severability.—If any provision of this act or the application thereof to any person or circumstance is held invalid, the invalidity shall not affect other provisions or applications of the act which can be given effect without the invalid provision or application, and to this end the provisions of this act are declared severable.

Section 18. Effective date—This act shall take effect on [appropriate date].